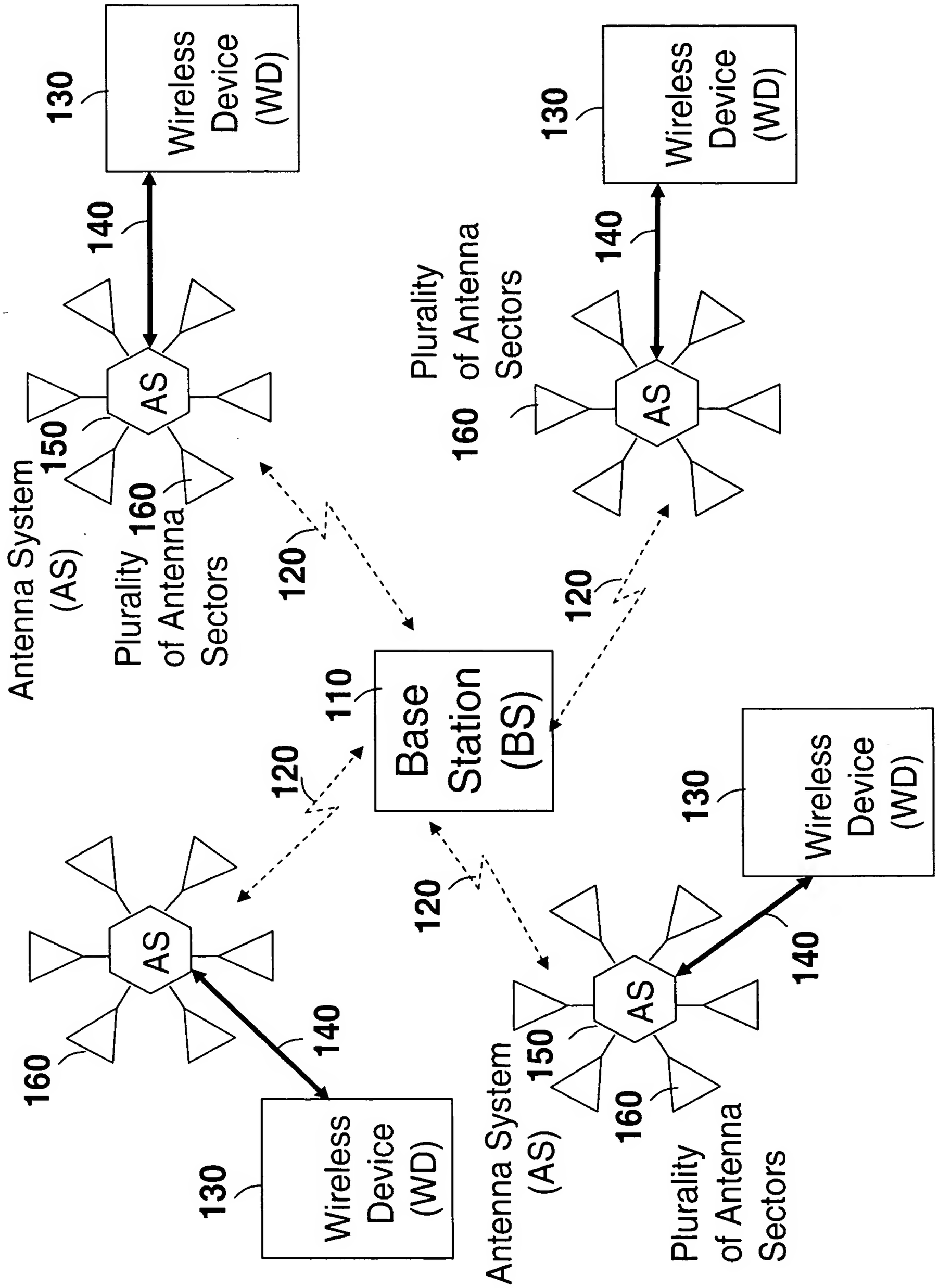

130
Wireless Device (WD)
140
150
AS
Antenna System (AS)
160
Plurality of Antenna Sectors
120
110
Base Station (BS)

Fig. 1

Fig. 2

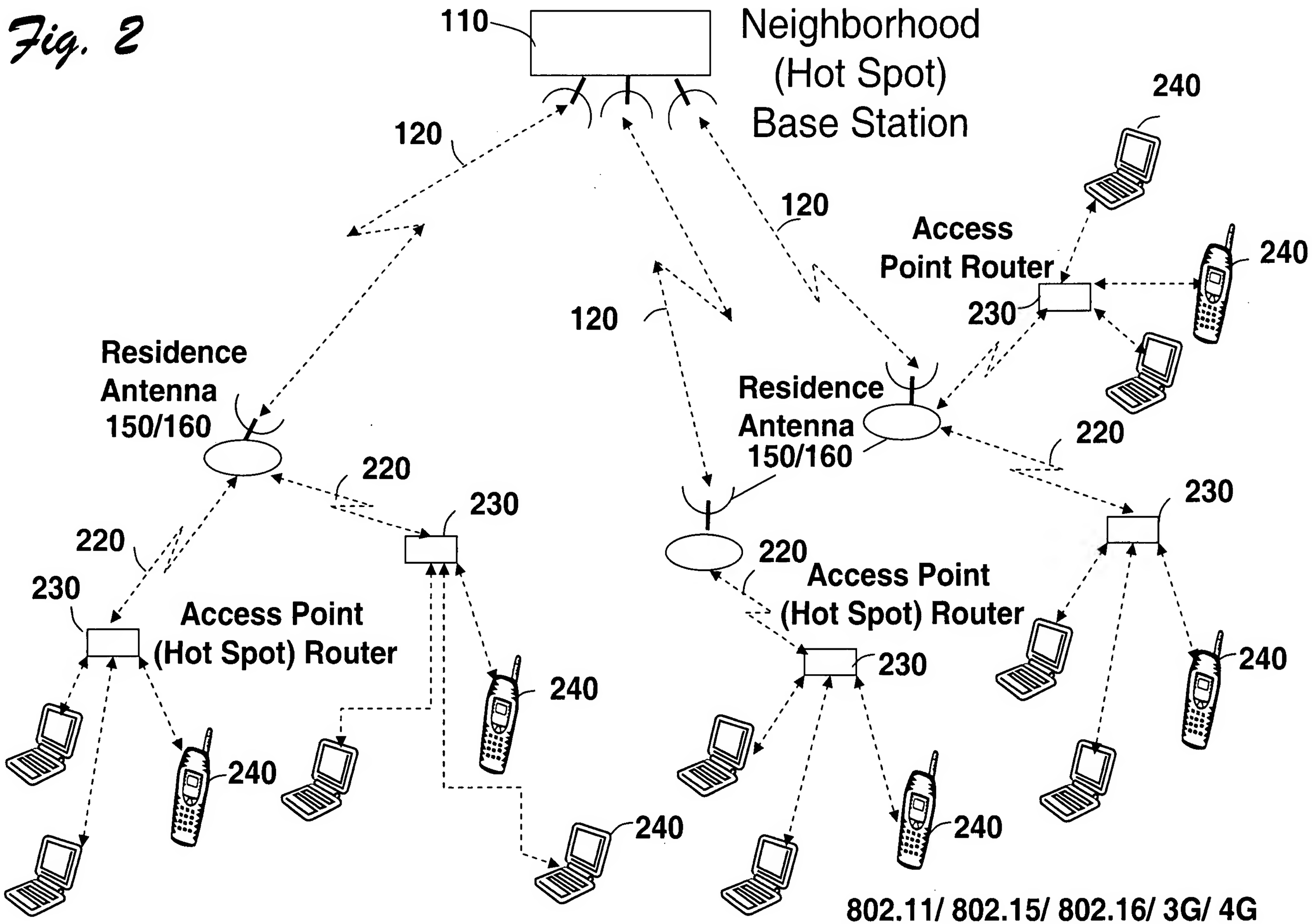
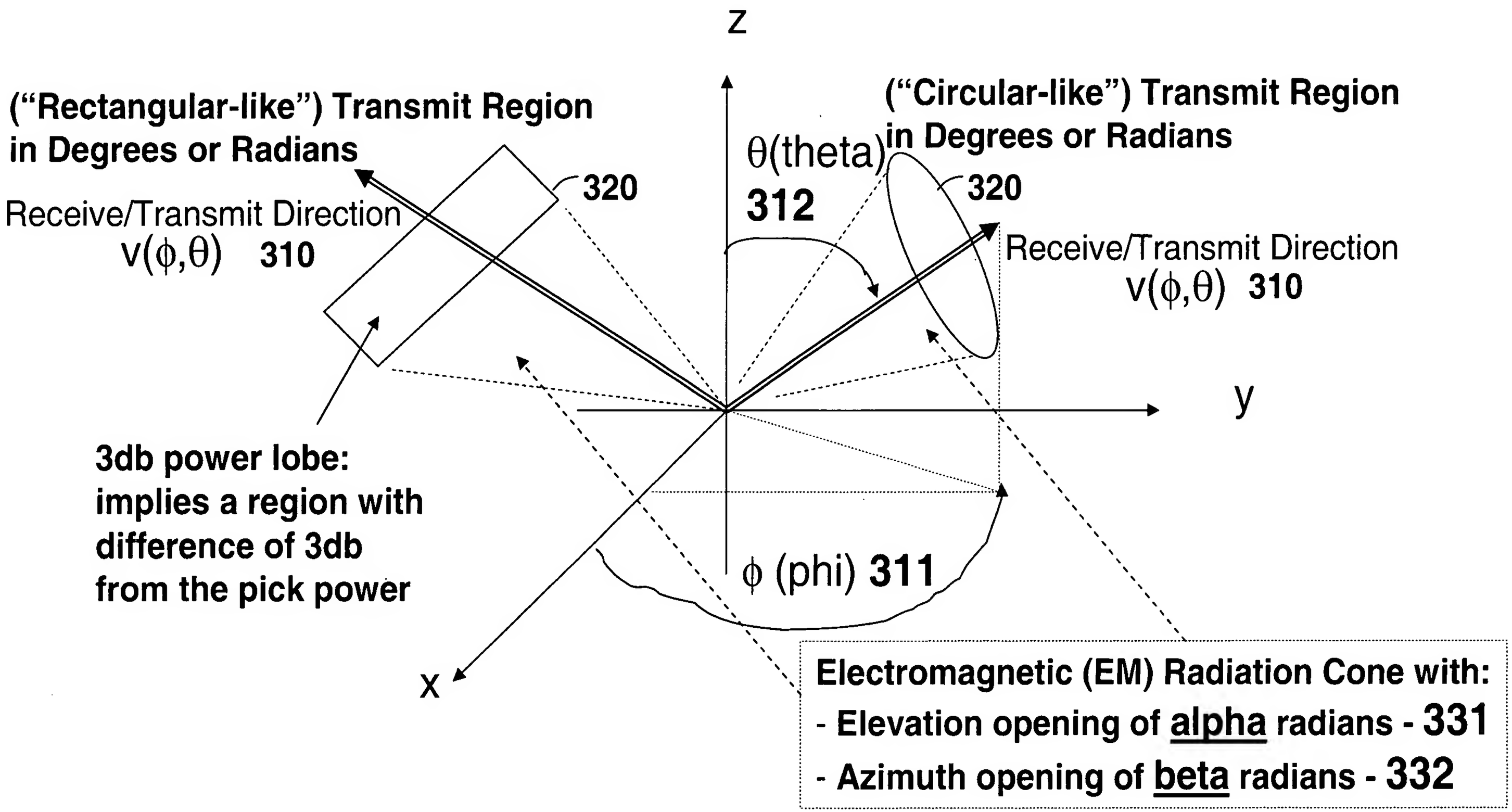

110
Neighborhood
(Hot Spot)
Base Station
120
120
120
240
Access
Point Router
230
240
Residence
Antenna
150/160
220
230
220
230
Access Point
(Hot Spot) Router
240
Residence
Antenna
150/160
220
230
220
Access Point
(Hot Spot) Router
230
240
240
240
802.11/ 802.15/ 802.16/ 3G/ 4G

Fig. 3

Each Antenna Sector **160** is Defined by:

1. Receive/Transmit **Direction** in 3D (Three Dimensional) Space, and
2. Receive/Transmit **Region**
   (the region perpendicular to the Receive/Transmits Direction in a defined distance)



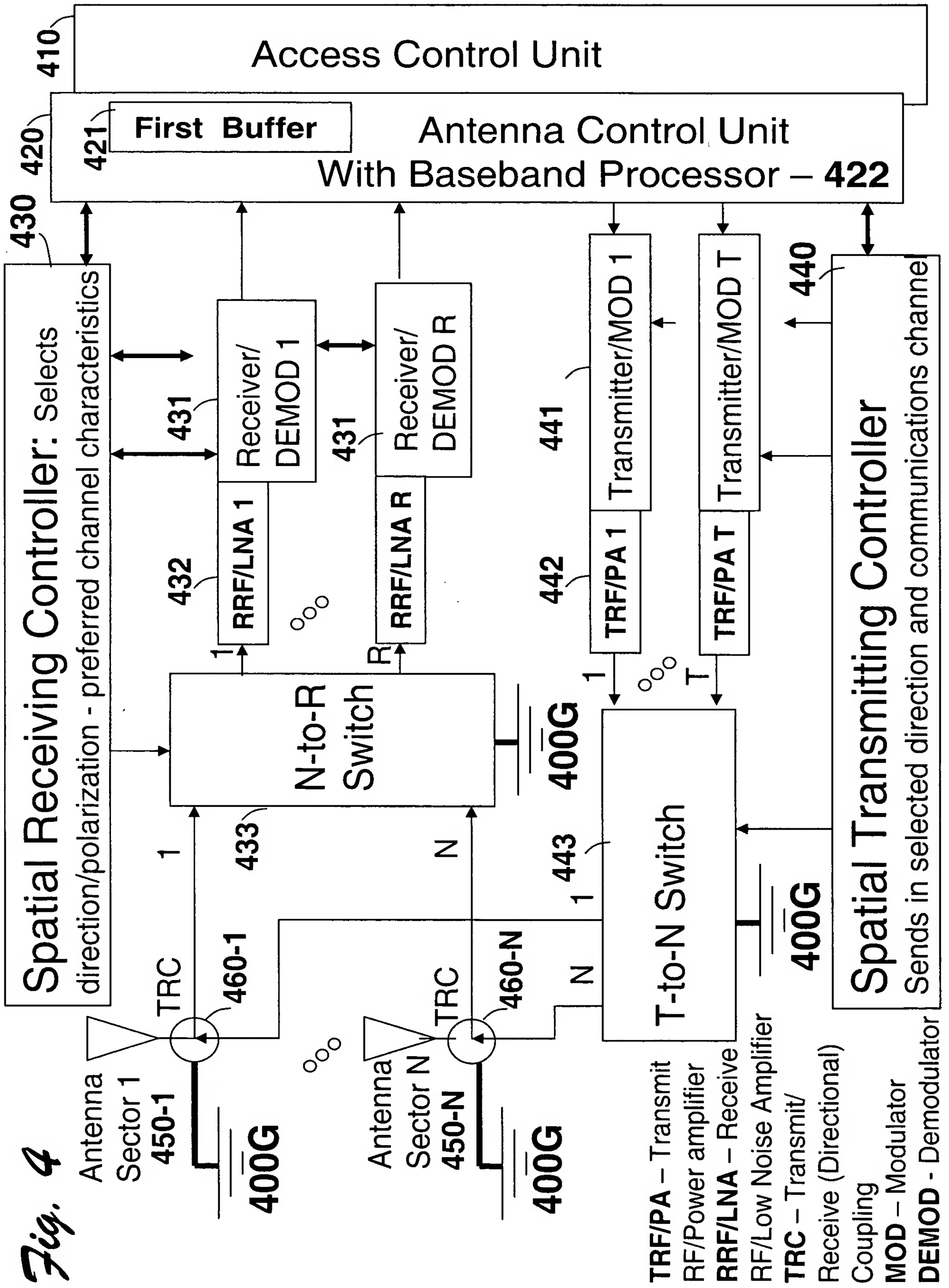

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
430
Spatial Receiving Controller: Selects direction/polarization - preferred channel characteristics
431
Receiver/ DEMOD 1
Receiver/ DEMOD R
432
RRF/LNA 1
RRF/LNA R
N-to-R Switch
400G
433
441
Transmitter/MOD 1
Transmitter/MOD T
442
TRF/PA 1
TRF/PA T
443
T-to-N Switch
440
Spatial Transmitting Controller
Sends in selected direction and communications channel
TRC
460-1
460-N
Antenna Sector 1
450-1
Antenna Sector N
450-N
TRF/PA – Transmit RF/Power amplifier
RRF/LNA – Receive RF/Low Noise Amplifier
TRC – Transmit/ Receive (Directional) Coupling
MOD – Modulator
DEMOD - Demodulator

Fig. 4

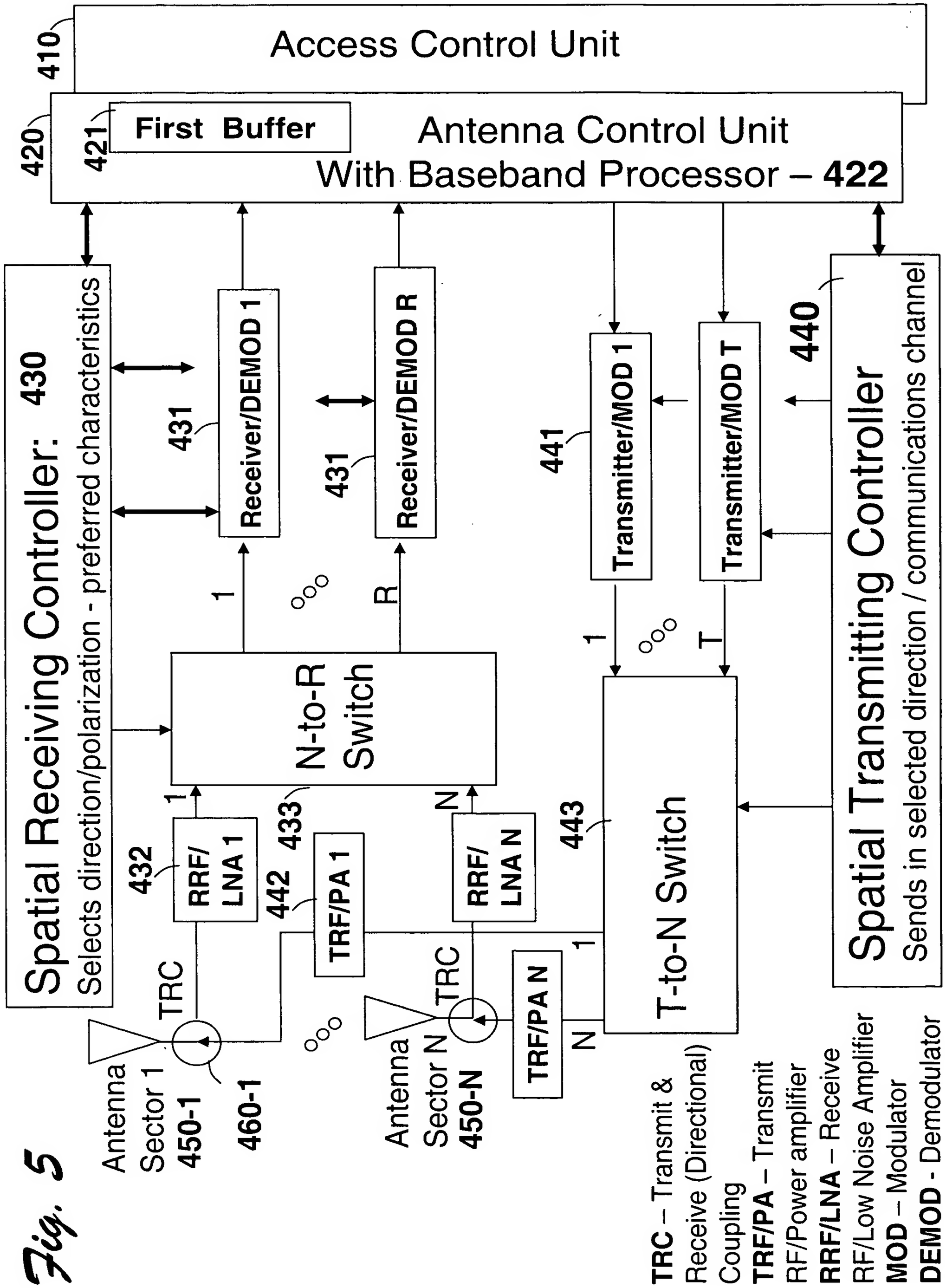

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
Spatial Receiving Controller: 430
Selects direction/polarization - preferred characteristics
431
Receiver/DEMOD 1
Receiver/DEMOD R
1
R
N-to-R Switch
Antenna Sector 1 450-1
Antenna Sector N 450-N
460-1
TRC
TRC
432
RRF/ LNA 1
RRF/ LNA N
433
442
TRF/PA 1
TRF/PA N
N
1
441
Transmitter/MOD 1
Transmitter/MOD T
T
443
T-to-N Switch
440
Spatial Transmitting Controller
Sends in selected direction / communications channel
TRC – Transmit & Receive (Directional) Coupling
TRF/PA – Transmit RF/Power amplifier
RRF/LNA – Receive RF/Low Noise Amplifier
MOD – Modulator
DEMOD - Demodulator

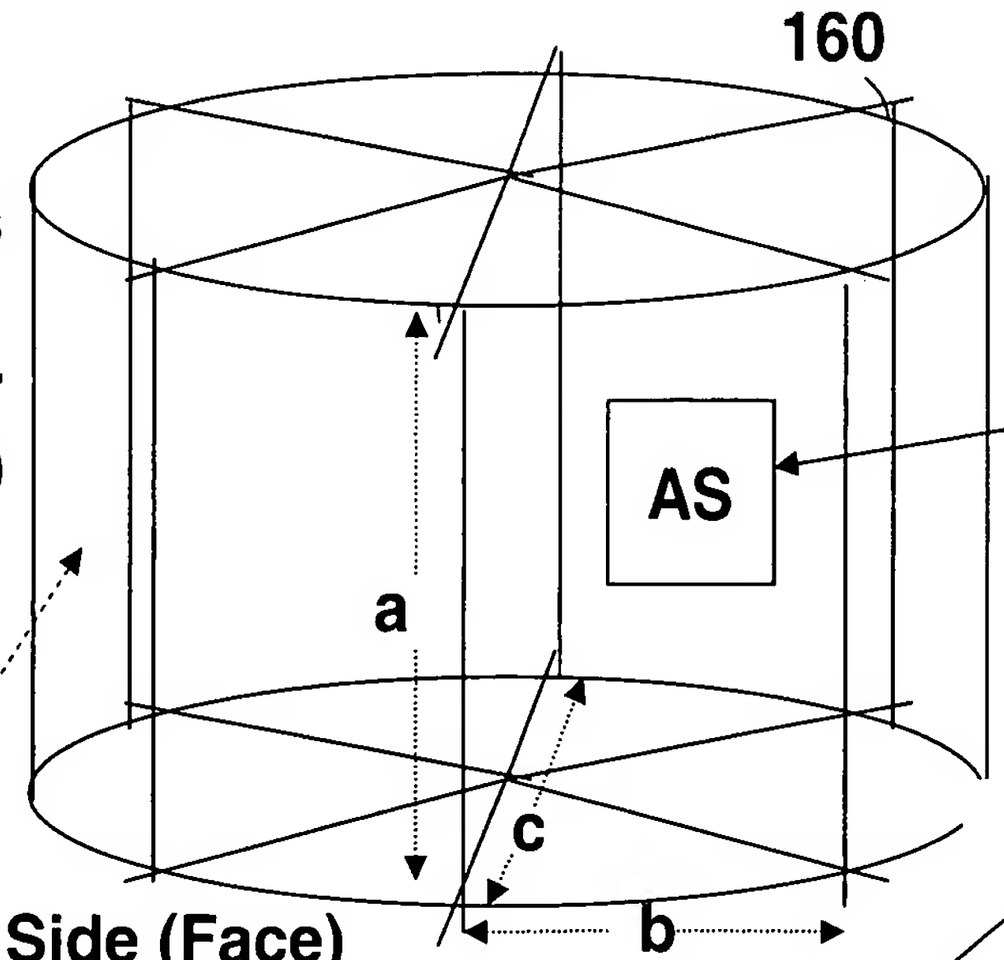
Fig. 5

Fig. 6

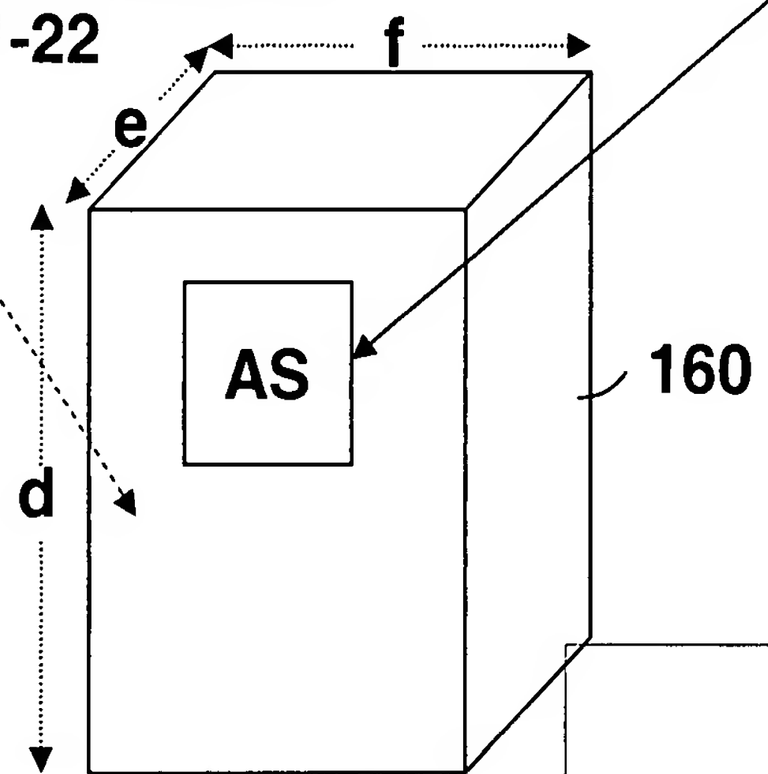
Antenna System (AS) - 150

Spatial Receiving Controller
Spatial Transmitting Controller
Receiver – RRF
Transmitter – TRF
N-to-R Switch
T-to-N Switch

Antenna Sectors Arranged on a Cylinder 610

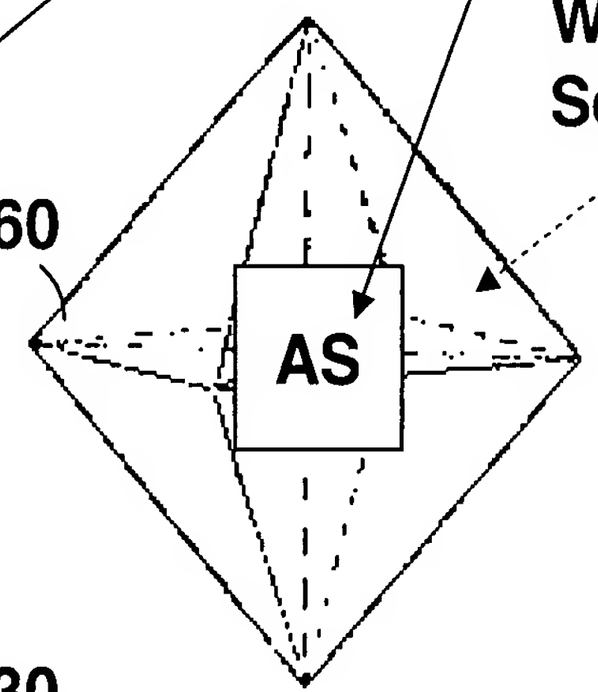


Each Flat Side (Face) With Multiple "Patches" See Figs. 21-22

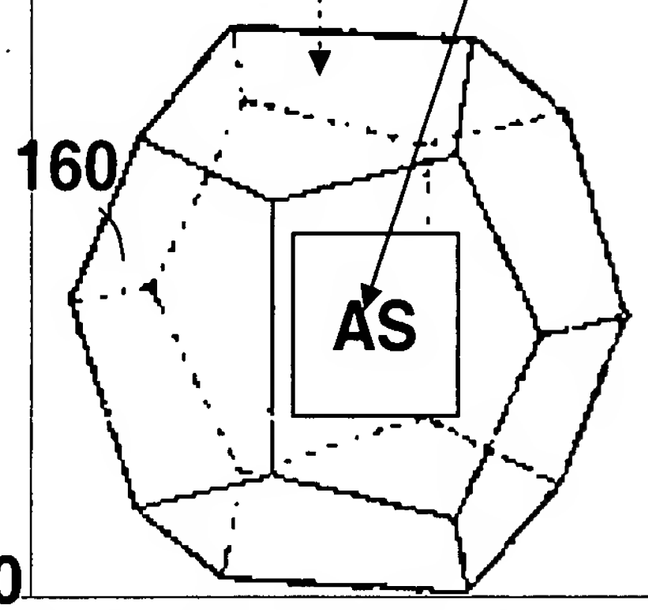


Antenna Sectors On a Cube 620

Each Side (Face) With Multiple Patches See Figs. 21-22



630
Antenna Sectors on an OCTAHEDRON



640
Antenna Sectors on a PENTAGONDODECAHEDRON

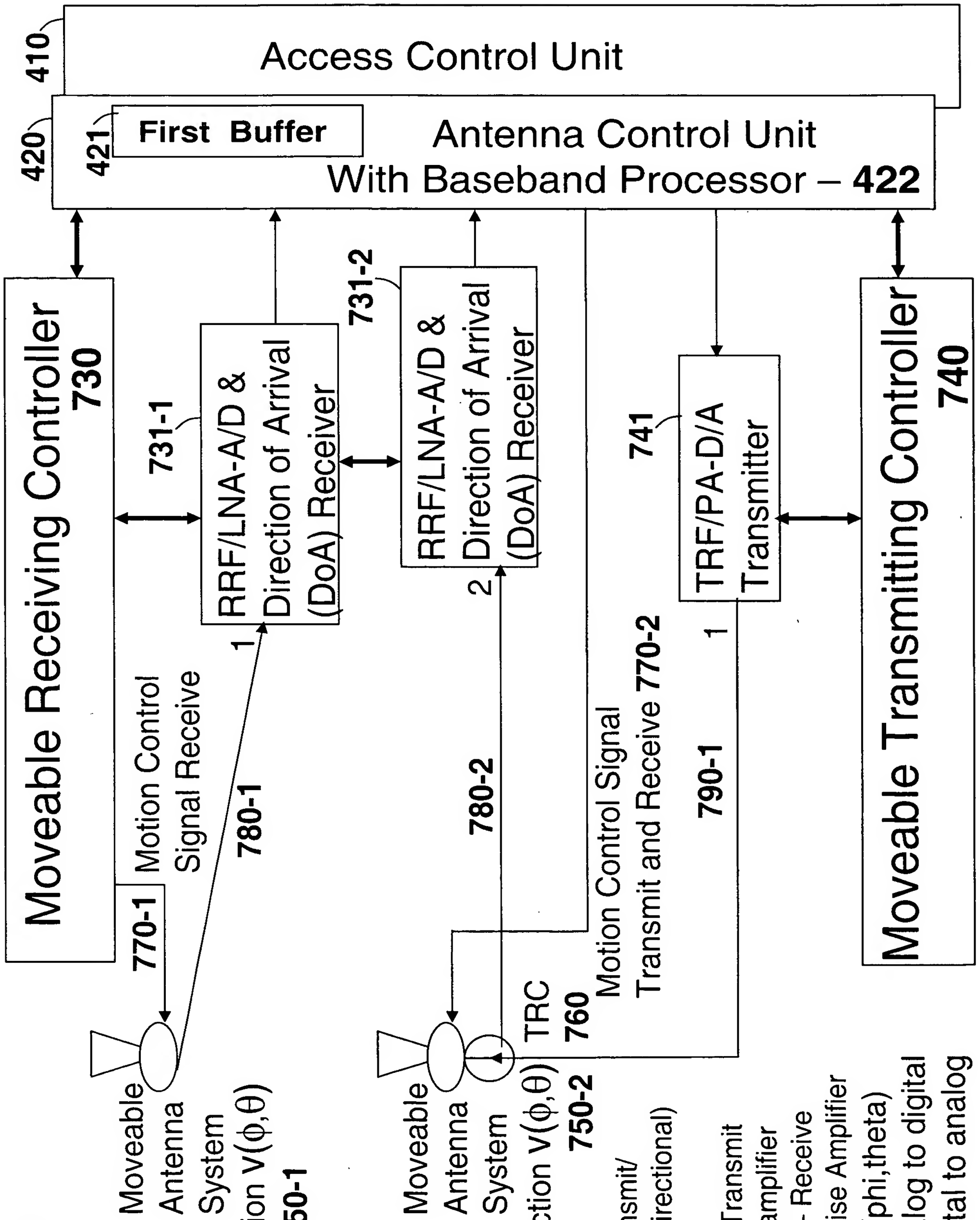
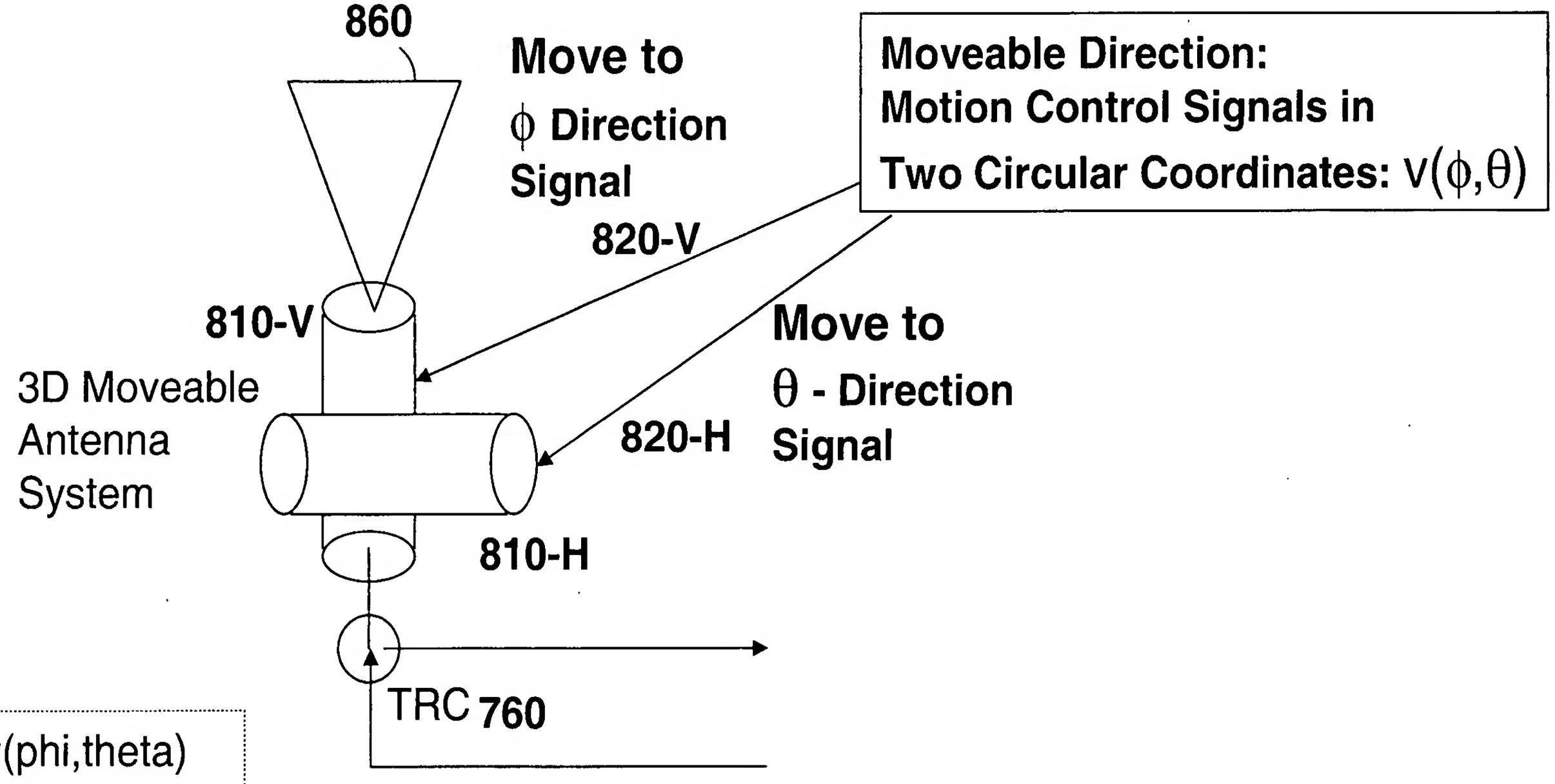

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
Moveable Receiving Controller
730
731-1
RRF/LNA-A/D &
Direction of Arrival
(DoA) Receiver
731-2
RRF/LNA-A/D &
Direction of Arrival
(DoA) Receiver
Motion Control
Signal Receive
770-1
780-1
780-2
1
2
Moveable
Antenna
System
Direction V(ϕ,θ)
750-1
TRC
760
Motion Control Signal
Transmit and Receive 770-2
741
TRF/PA-D/A
Transmitter
790-1
Moveable Transmitting Controller
740
Moveable
Antenna
System
Direction V(ϕ,θ)
750-2
TRC – Transmit/
Receive (Directional)
Coupling
TRF/PA – Transmit
RF/Power amplifier
RRF/LNA – Receive
RF/Low Noise Amplifier
v(ϕ,θ) – v(phi,theta)
A/D – analog to digital
D/A – digital to analog

Fig. 7

Fig. 8

Antenna System (AS) – 750
(step-motor / electric motor / electric field)



v(ϕ,θ) – v(phi,theta)
TRC –
Transmit/
Receive (Directional)
Coupling

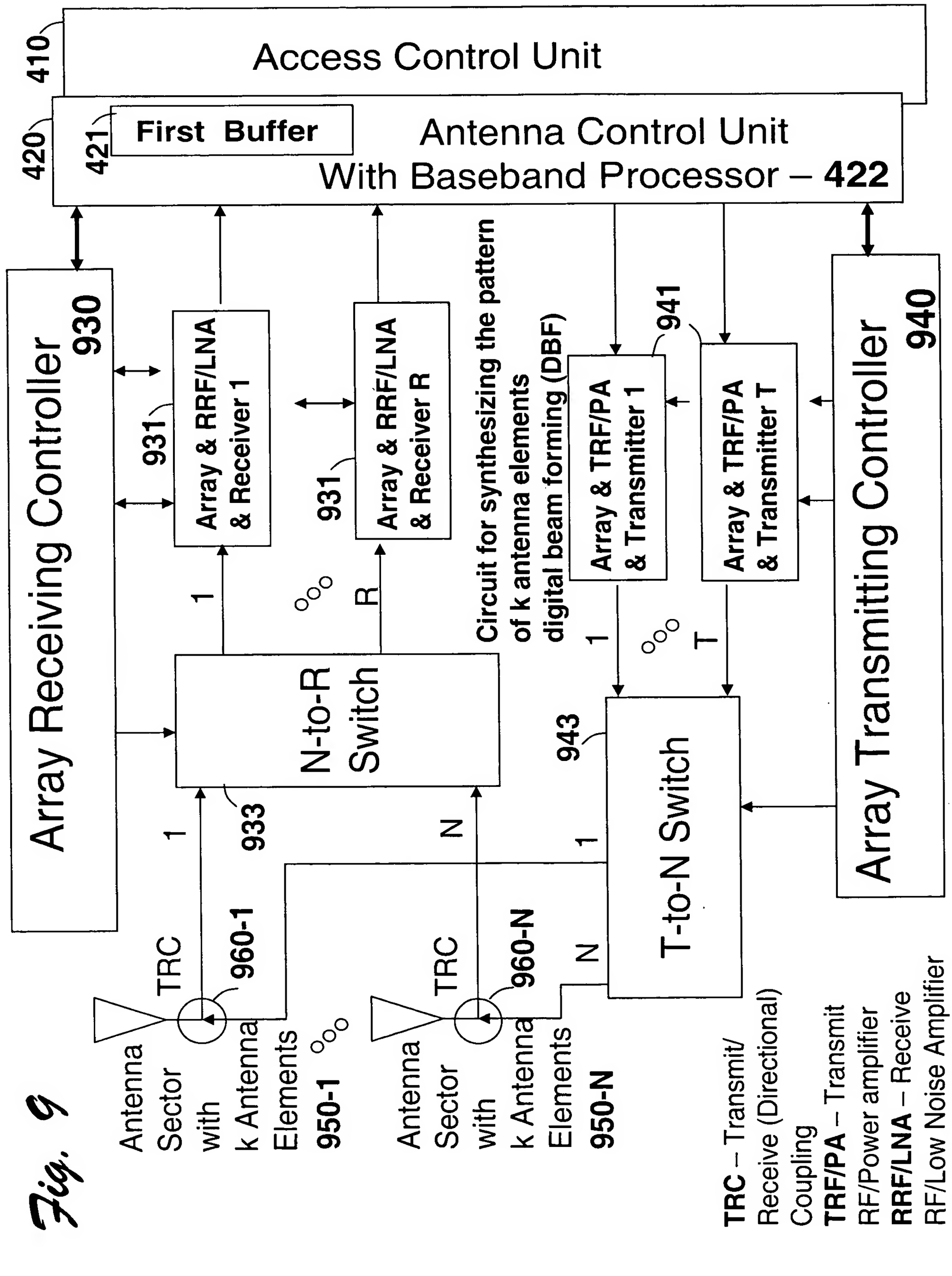

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
Array Receiving Controller
930
931
Array & RRF/LNA
& Receiver 1
931
Array & RRF/LNA
& Receiver R
1
R
N-to-R
Switch
933
Circuit for synthesizing the pattern
of k antenna elements
digital beam forming (DBF)
941
Array & TRF/PA
& Transmitter 1
Array & TRF/PA
& Transmitter T
1
T
943
T-to-N Switch
N
1
Array Transmitting Controller
940
Antenna
Sector
with
k Antenna
Elements
950-1
TRC
1
960-1
Antenna
Sector
with
k Antenna
Elements
950-N
TRC
N
960-N
TRC – Transmit/
Receive (Directional)
Coupling
TRF/PA – Transmit
RF/Power amplifier
RRF/LNA – Receive
RF/Low Noise Amplifier

Fig. 9

Fig. 10

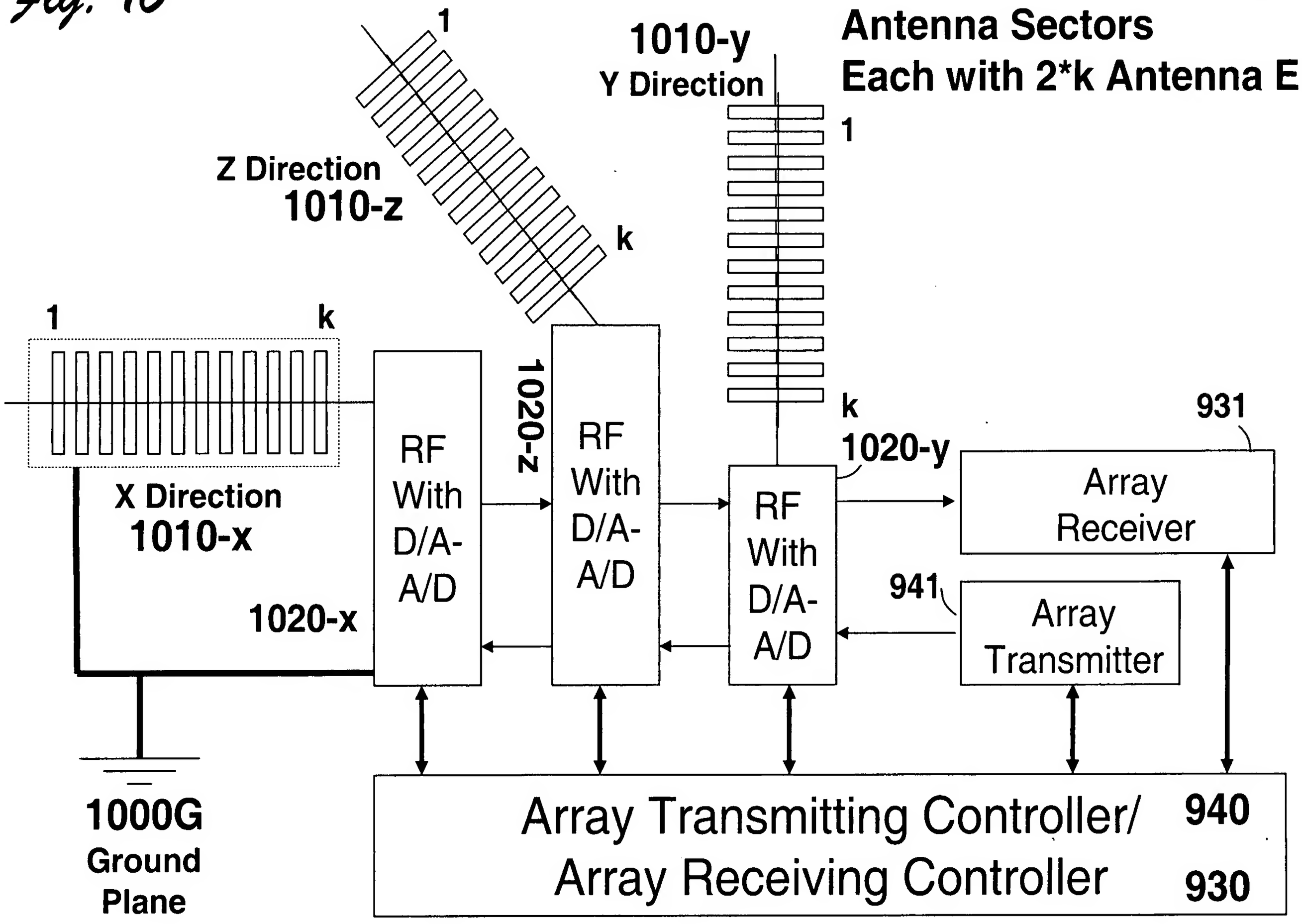

Plurality of Phase Array
Antenna Sectors
Each with 2*k Antenna Elements
1
Z Direction
1010-z
k
1010-y
Y Direction
1
k
1
k
X Direction
1010-x
1020-x
1020-z
1020-y
931
RF
With
D/A-
A/D
RF
With
D/A-
A/D
RF
With
D/A-
A/D
Array
Receiver
941
Array
Transmitter
Array Transmitting Controller/
Array Receiving Controller
940
930
1000G
Ground
Plane

Fig. 11

Access Control Unit - 410

Send Data Packet Procedure: 1100

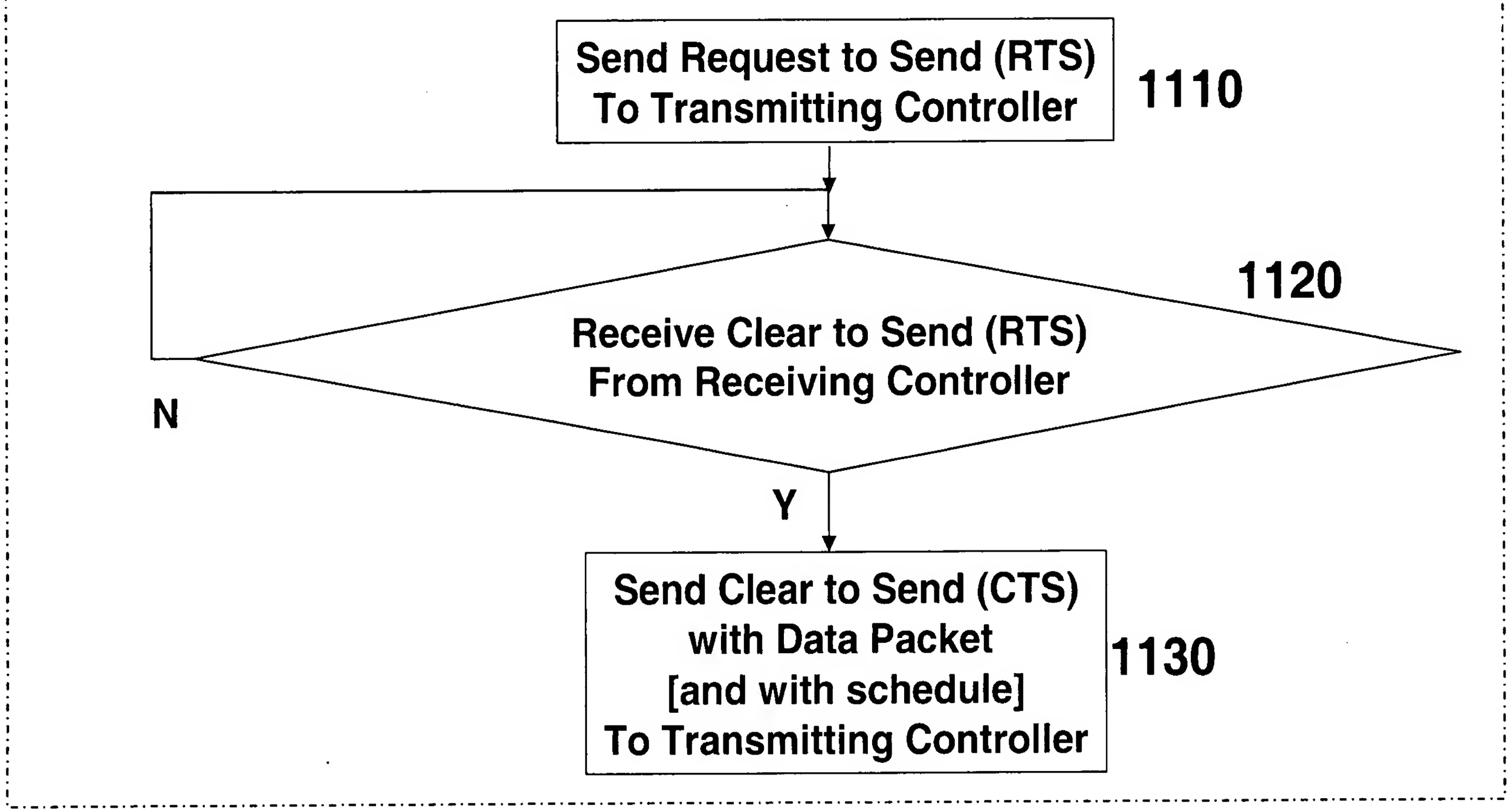


Fig. 12

Antenna Control Unit - 420

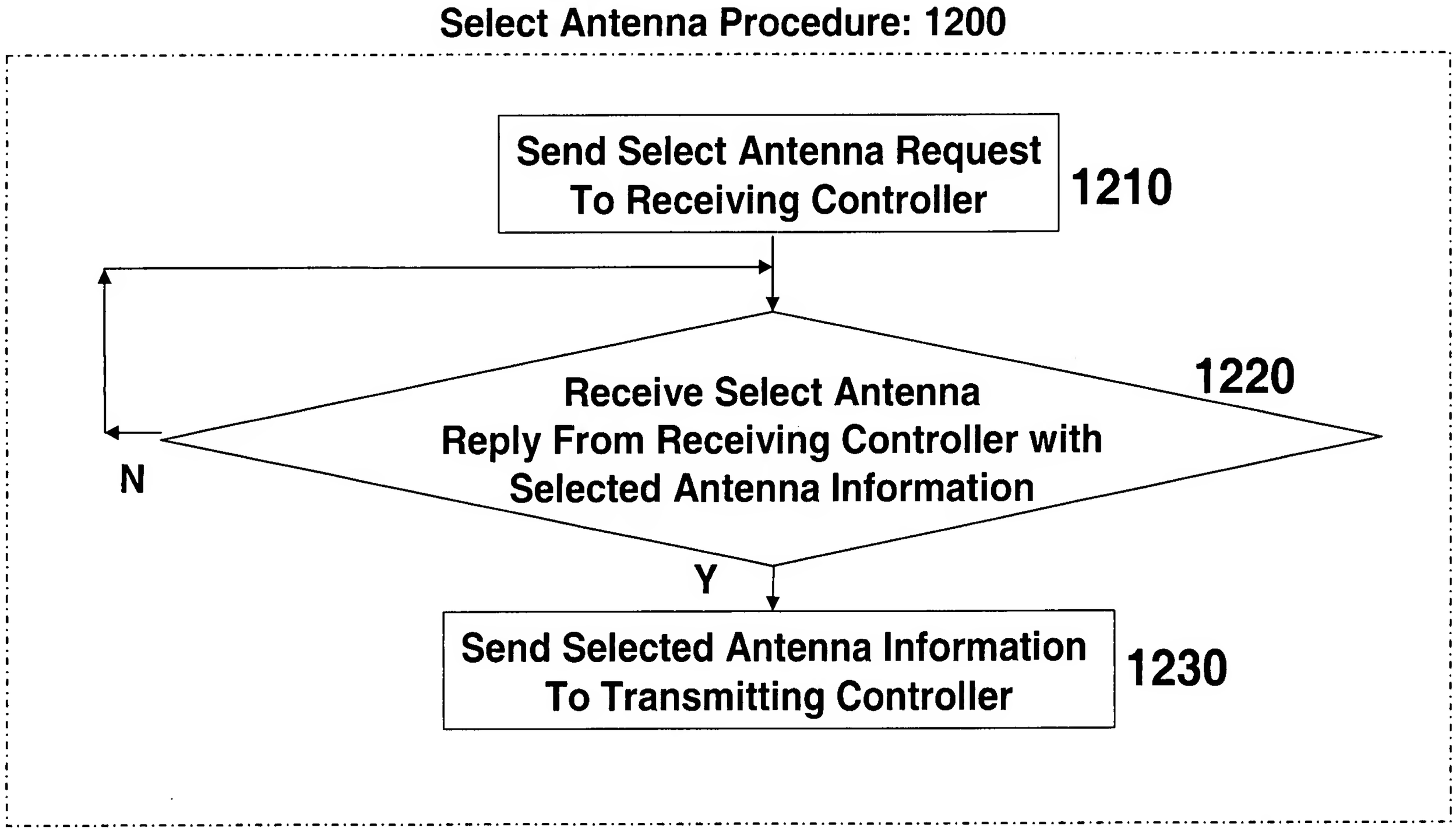


Fig. 13

Spatial Receiving Controller - 430

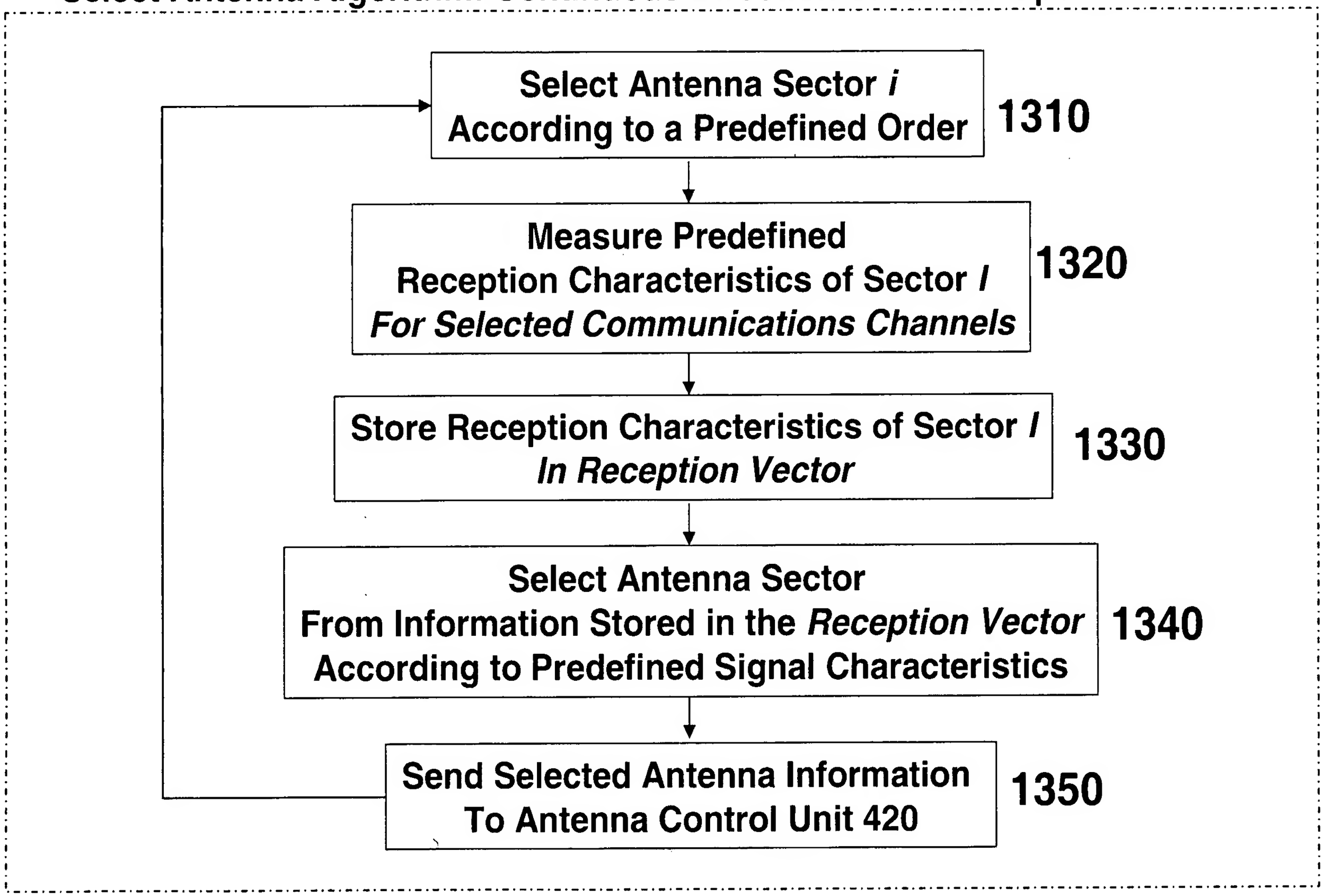


Fig. 14

Spatial Transmitting Controller - 440

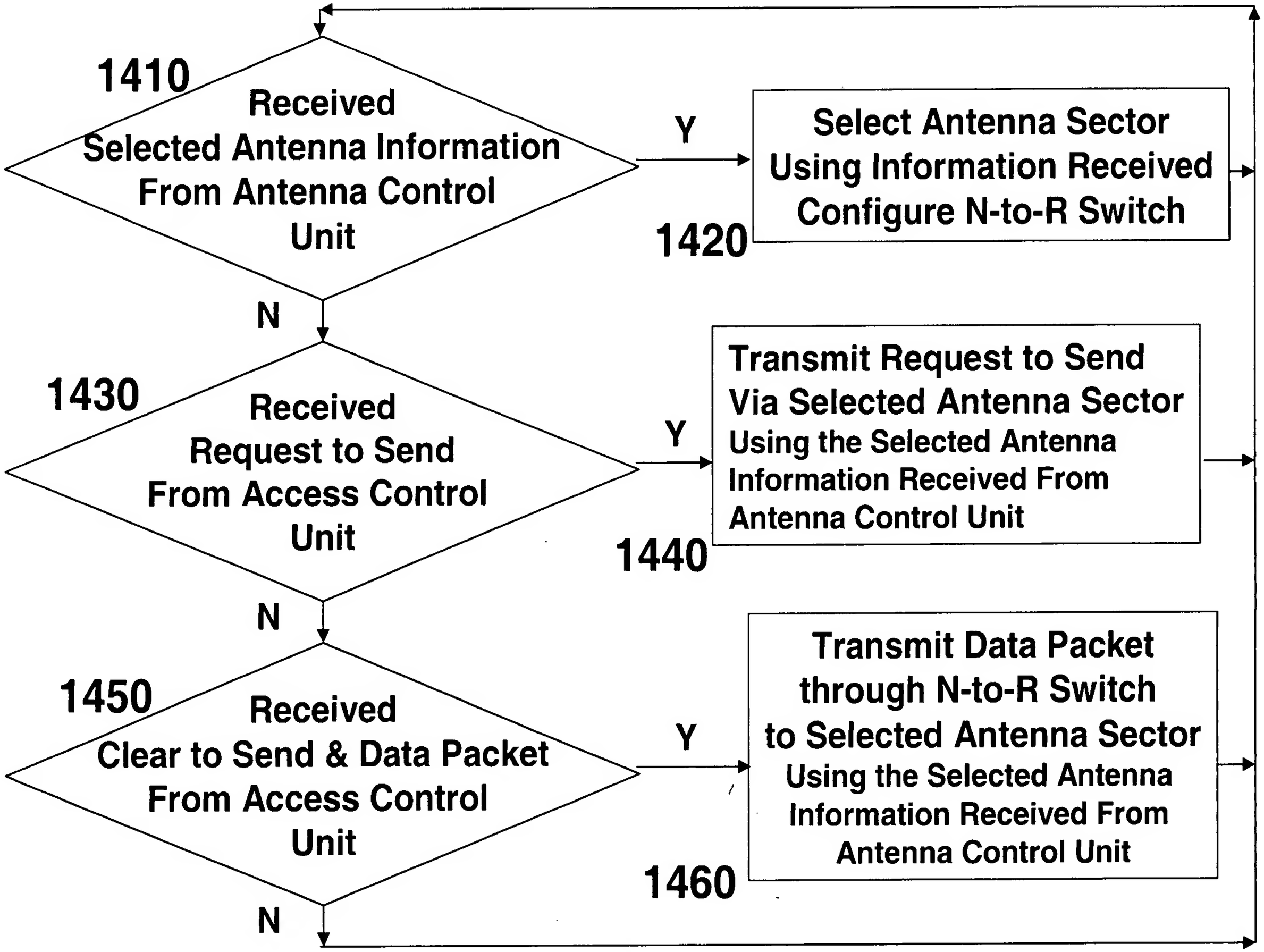
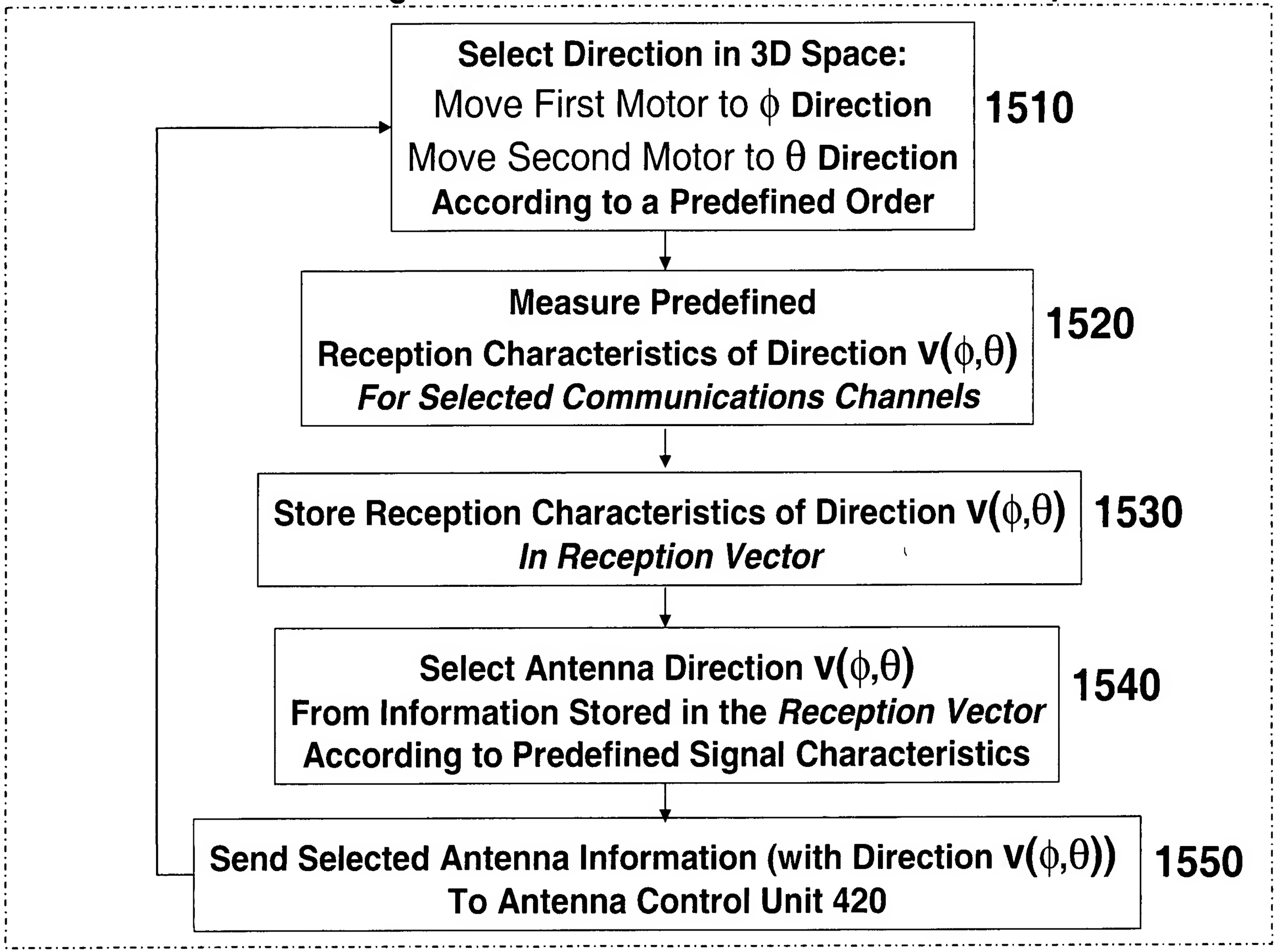


Fig. 15

Moveable Receiving Controller – 730

Select Direction Algorithm: Continuous Direction-of-Arrival Operation 1500



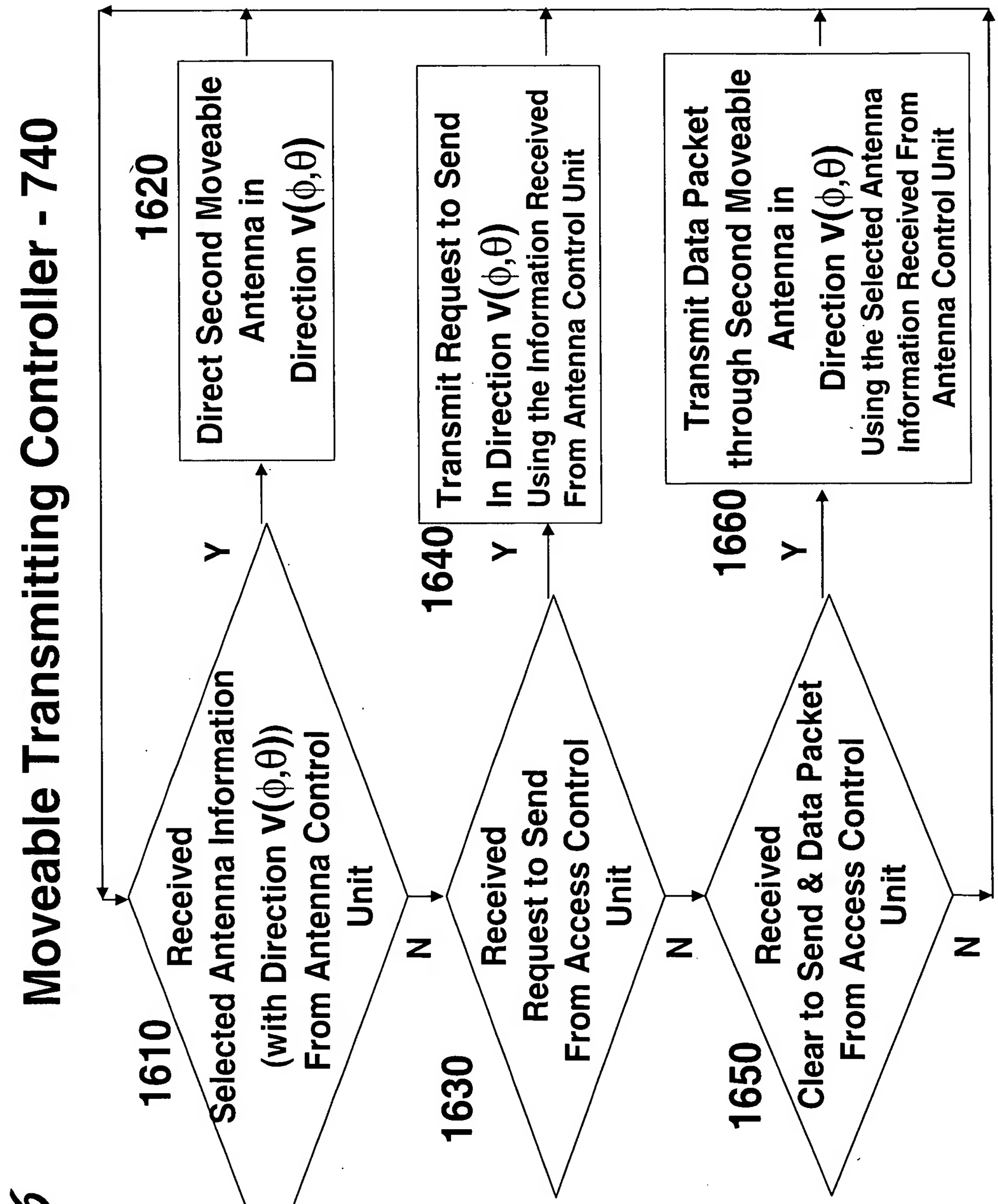

Moveable Transmitting Controller - 740
1610
Received Selected Antenna Information (with Direction V(ϕ,θ)) From Antenna Control Unit
Y
1620
Direct Second Moveable Antenna in Direction V(ϕ,θ)
N
1630
Received Request to Send From Access Control Unit
Y
1640
Transmit Request to Send In Direction V(ϕ,θ) Using the Information Received From Antenna Control Unit
N
1650
Received Clear to Send & Data Packet From Access Control Unit
Y
1660
Transmit Data Packet through Second Moveable Antenna in Direction V(ϕ,θ) Using the Selected Antenna Information Received From Antenna Control Unit
N

Fig. 16

Fig. 17

Array Receiving Controller - 930

Select Direction Algorithm: Continuous Direction-of-Arrival Operation 1700

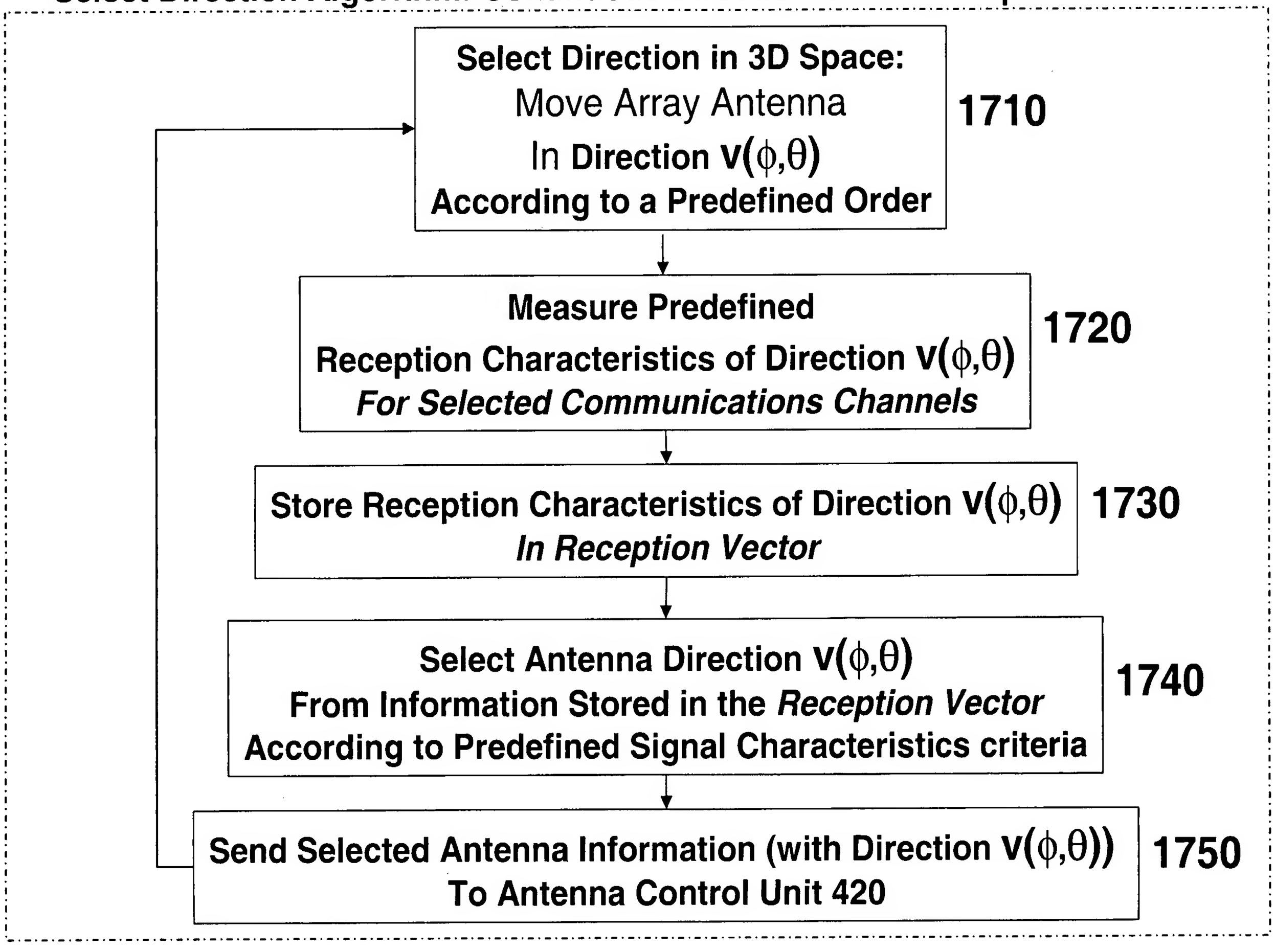


Fig. 18

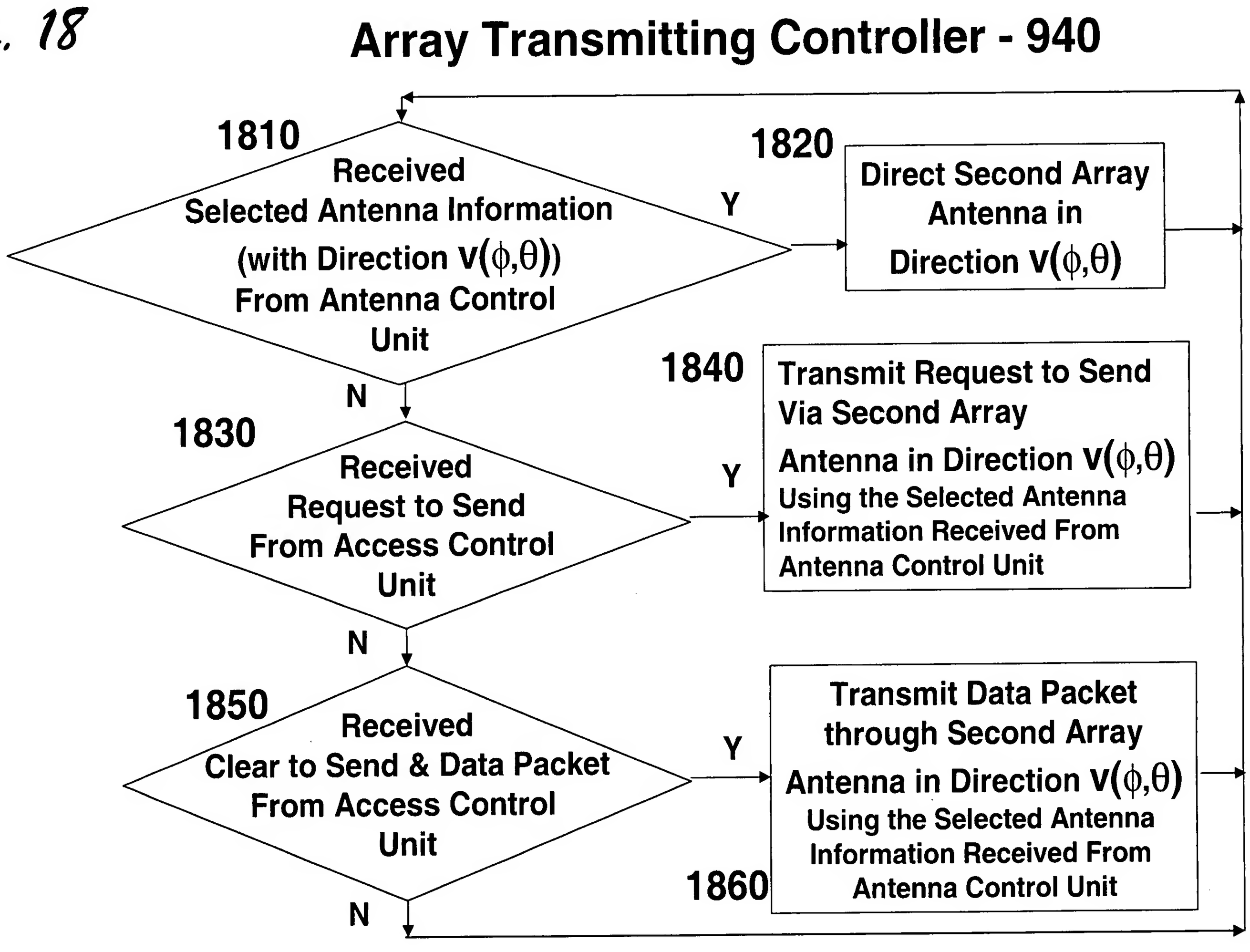

Array Transmitting Controller - 940
1810
Received Selected Antenna Information (with Direction V(ϕ,θ)) From Antenna Control Unit
Y
1820
Direct Second Array Antenna in Direction V(ϕ,θ)
N
1830
Received Request to Send From Access Control Unit
Y
1840
Transmit Request to Send Via Second Array Antenna in Direction V(ϕ,θ) Using the Selected Antenna Information Received From Antenna Control Unit
N
1850
Received Clear to Send & Data Packet From Access Control Unit
Y
1860
Transmit Data Packet through Second Array Antenna in Direction V(ϕ,θ) Using the Selected Antenna Information Received From Antenna Control Unit
N

Fig. 19

End (Mobile) Device Transmits and Receives on Different Frequencies – Selecting Transmit Antenna Sector

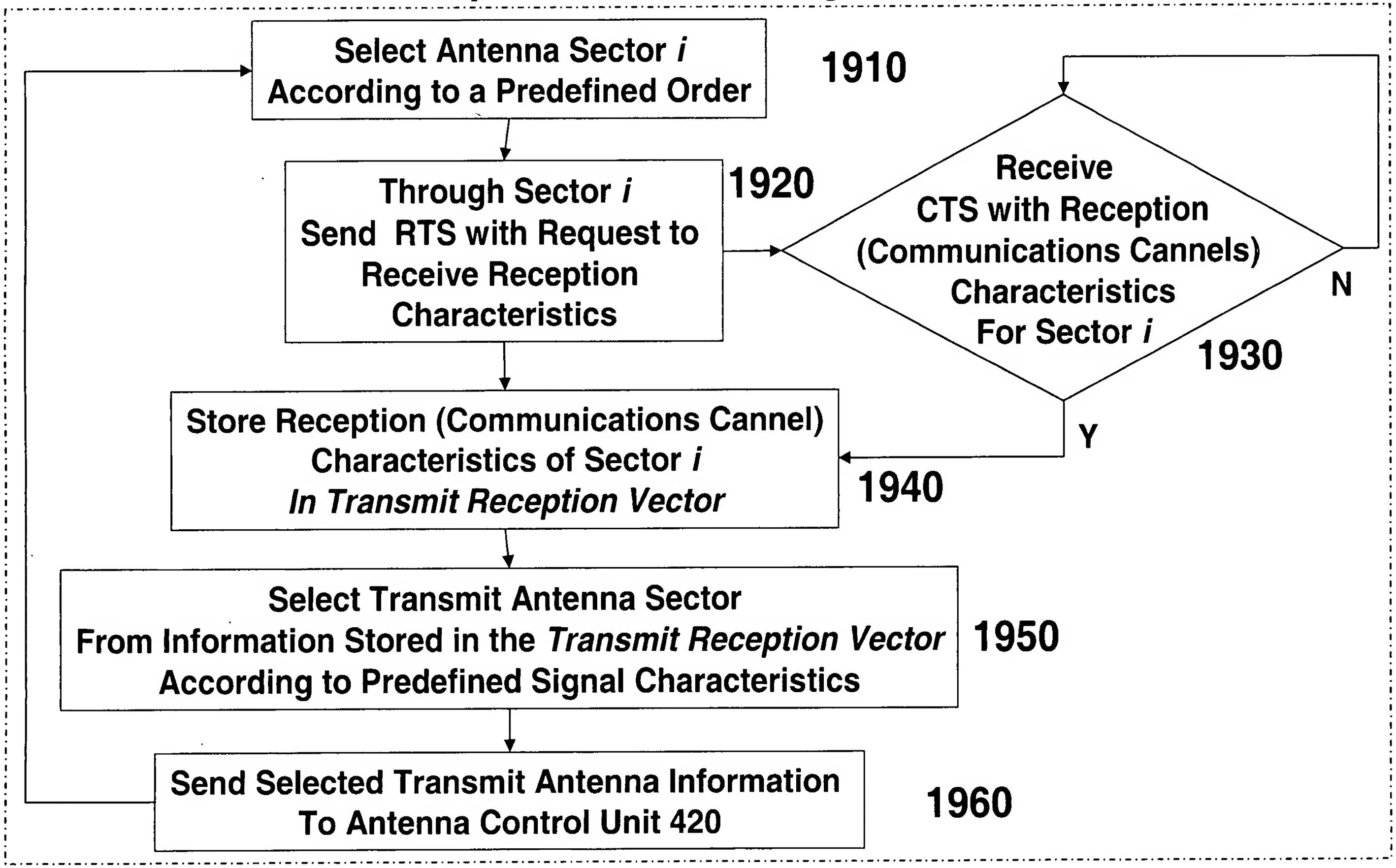
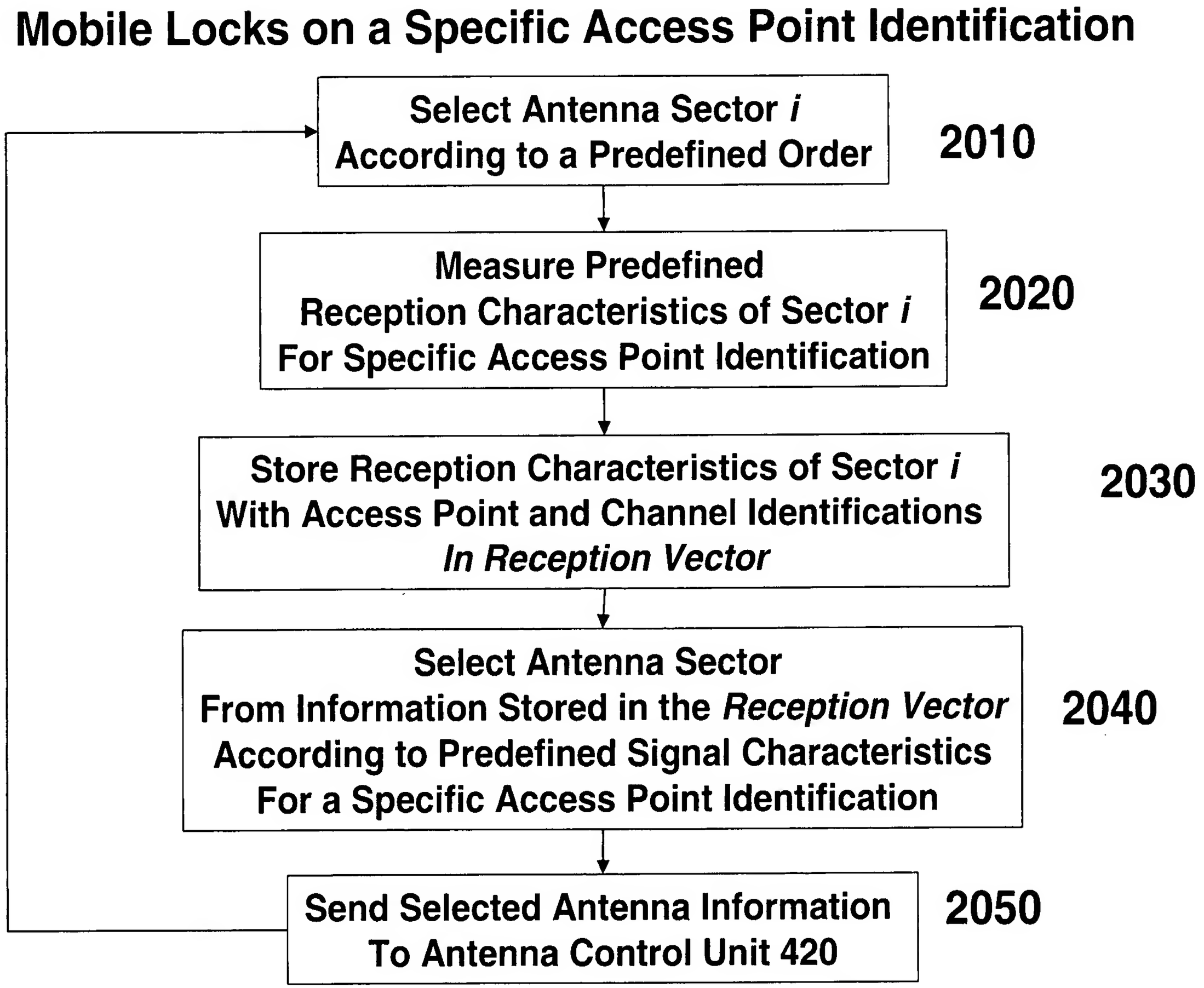


Fig. 20


Mobile Locks on a Specific Access Point Identification
Select Antenna Sector *i* According to a Predefined Order
2010
Measure Predefined Reception Characteristics of Sector *i* For Specific Access Point Identification
2020
Store Reception Characteristics of Sector *i* With Access Point and Channel Identifications *In Reception Vector*
2030
Select Antenna Sector From Information Stored in the *Reception Vector* According to Predefined Signal Characteristics For a Specific Access Point Identification
2040
Send Selected Antenna Information To Antenna Control Unit 420
2050

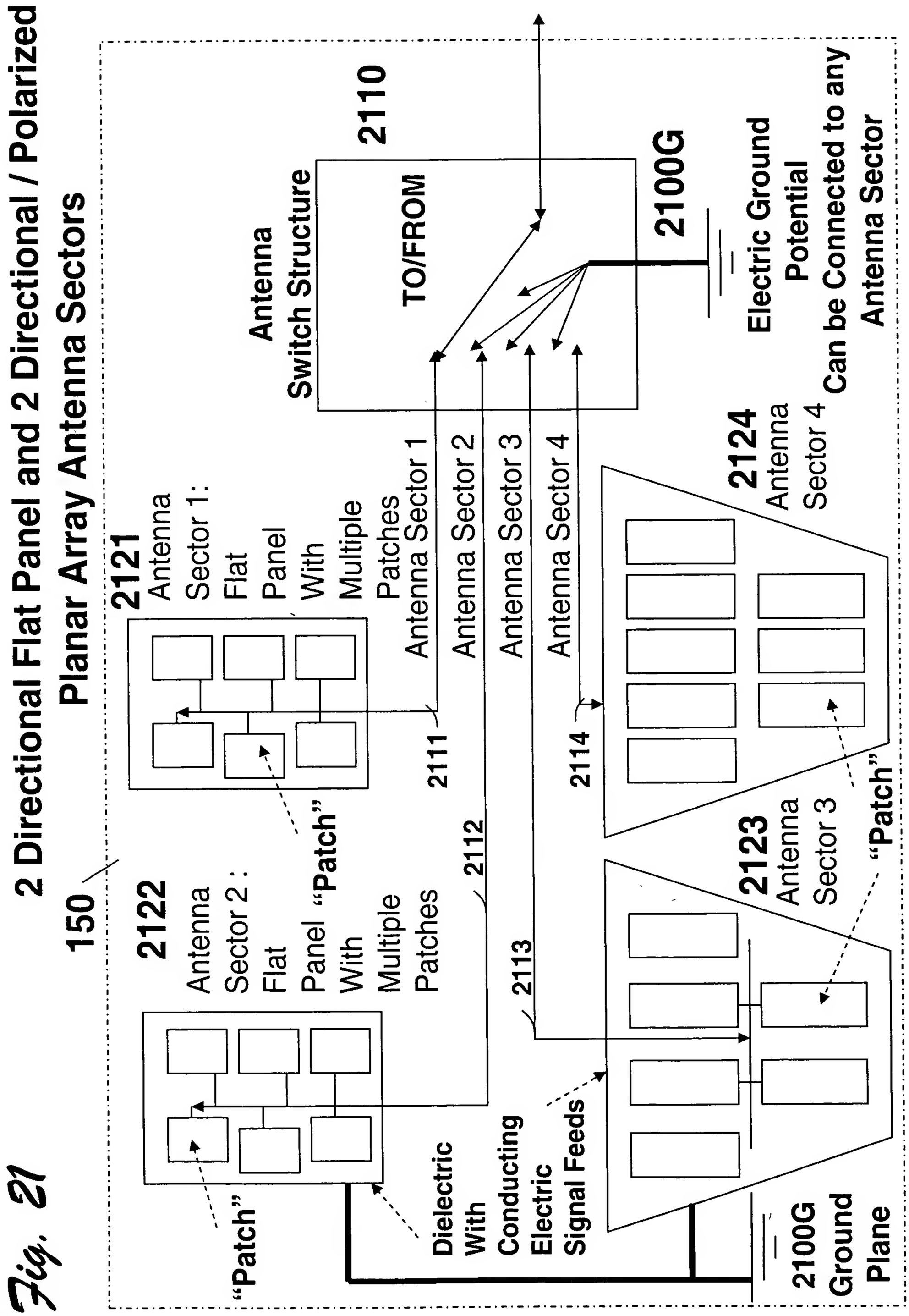

2 Directional Flat Panel and 2 Directional / Polarized Planar Array Antenna Sectors
150
2110
Antenna Switch Structure
TO/FROM
2100G
Electric Ground Potential Can be Connected to any Antenna Sector
2121
Antenna Sector 1: Flat Panel With Multiple Patches
"Patch"
2111
Antenna Sector 1
Antenna Sector 2
Antenna Sector 3
Antenna Sector 4
2112
2114
2124
Antenna Sector 4
2123
Antenna Sector 3
2122
Antenna Sector 2: Flat Panel "Patch" With Multiple Patches
2113
Dielectric With Conducting Electric Signal Feeds
2100G
Ground Plane

Fig. 21

Fig. 22

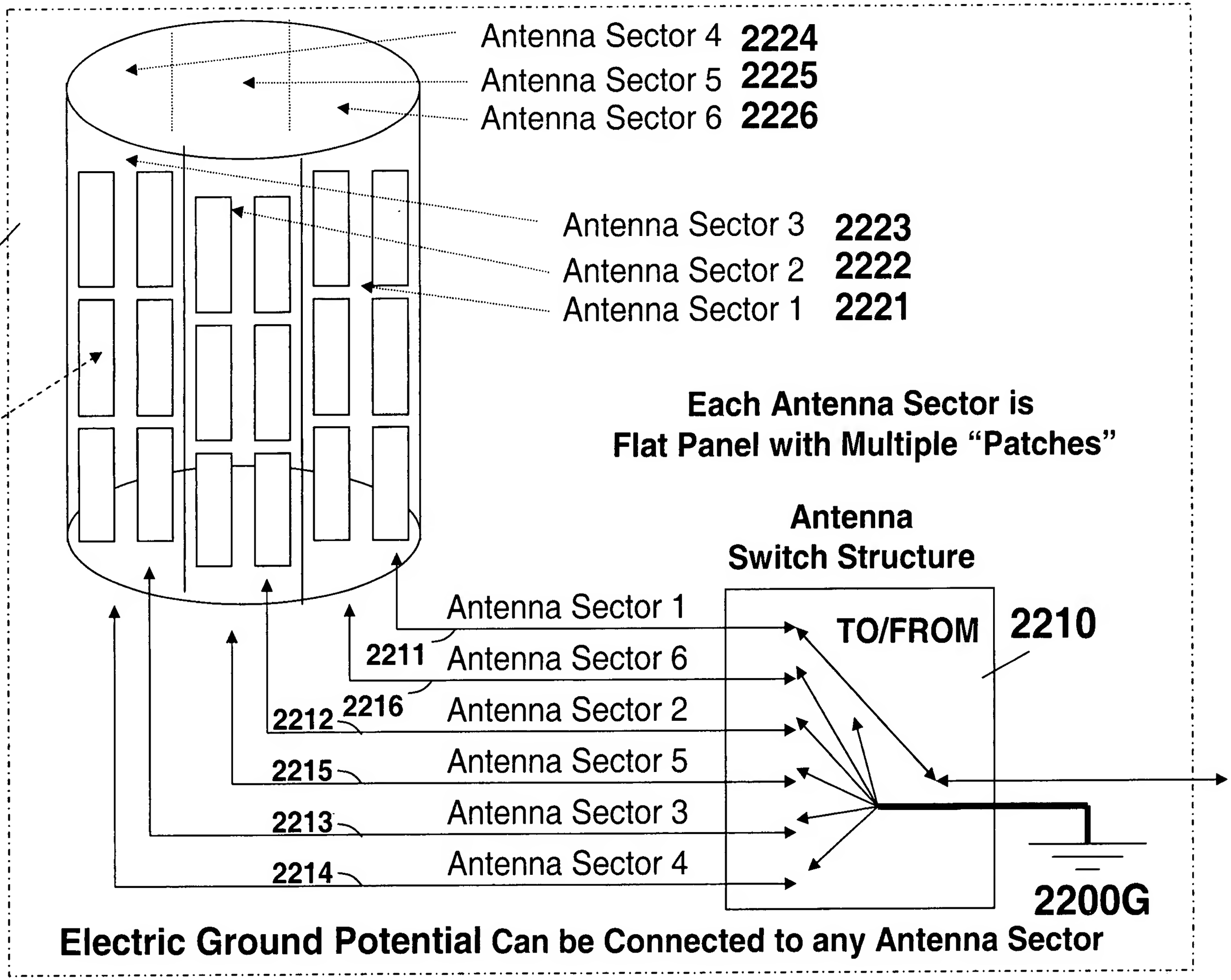
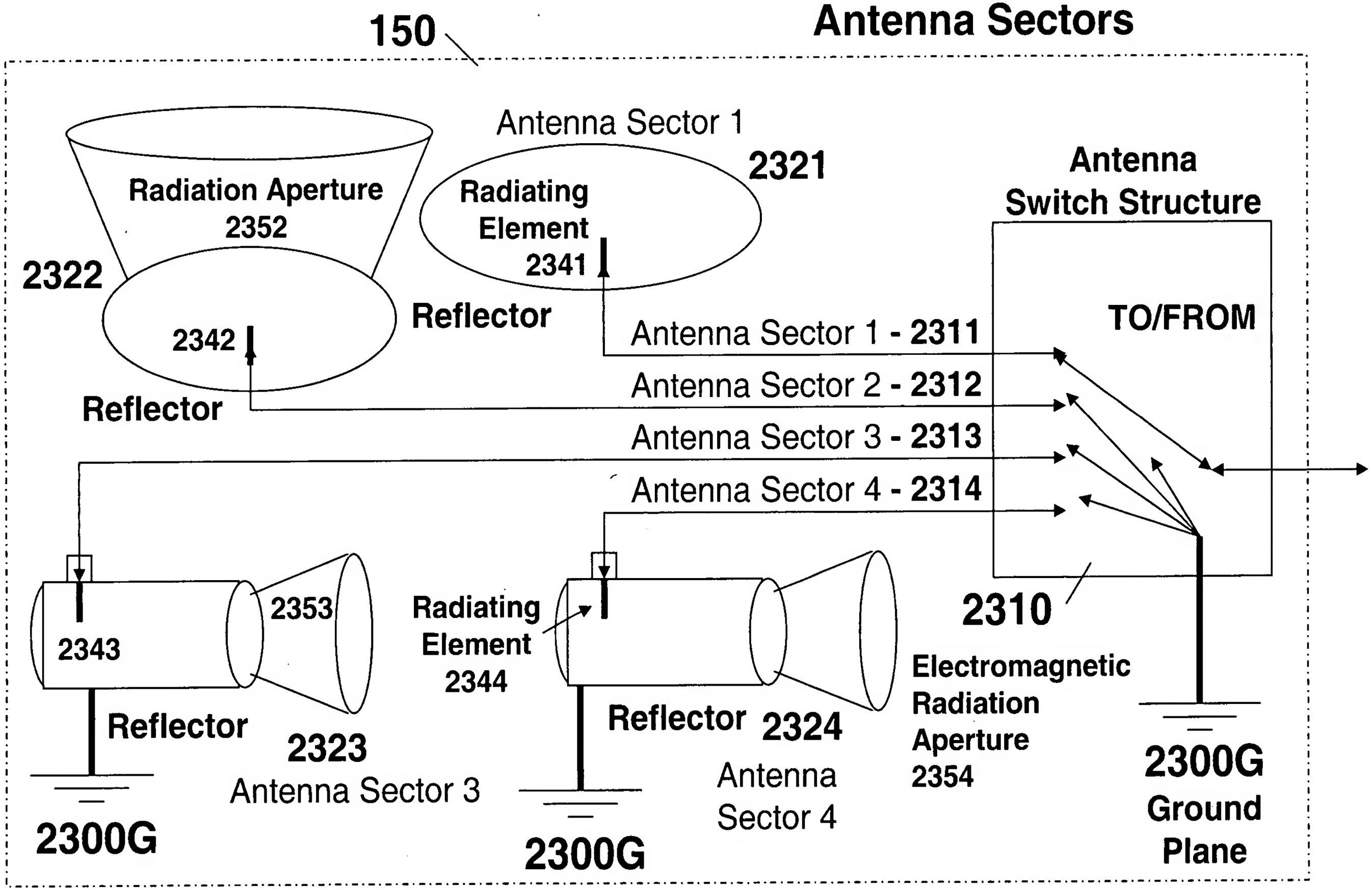

Antenna Sector 4 2224
Antenna Sector 5 2225
Antenna Sector 6 2226
150
Antenna Sector 3 2223
Antenna Sector 2 2222
Antenna Sector 1 2221
"Patch"
Each Antenna Sector is
Flat Panel with Multiple "Patches"
Antenna
Switch Structure
Antenna Sector 1
TO/FROM
2210
2211
Antenna Sector 6
2216
2212
Antenna Sector 2
2215
Antenna Sector 5
2213
Antenna Sector 3
2214
Antenna Sector 4
2200G
Electric Ground Potential Can be Connected to any Antenna Sector

Fig. 23

4 Directional Parabolic-dish-reflector or Yagi/Tube-like Antenna Sectors



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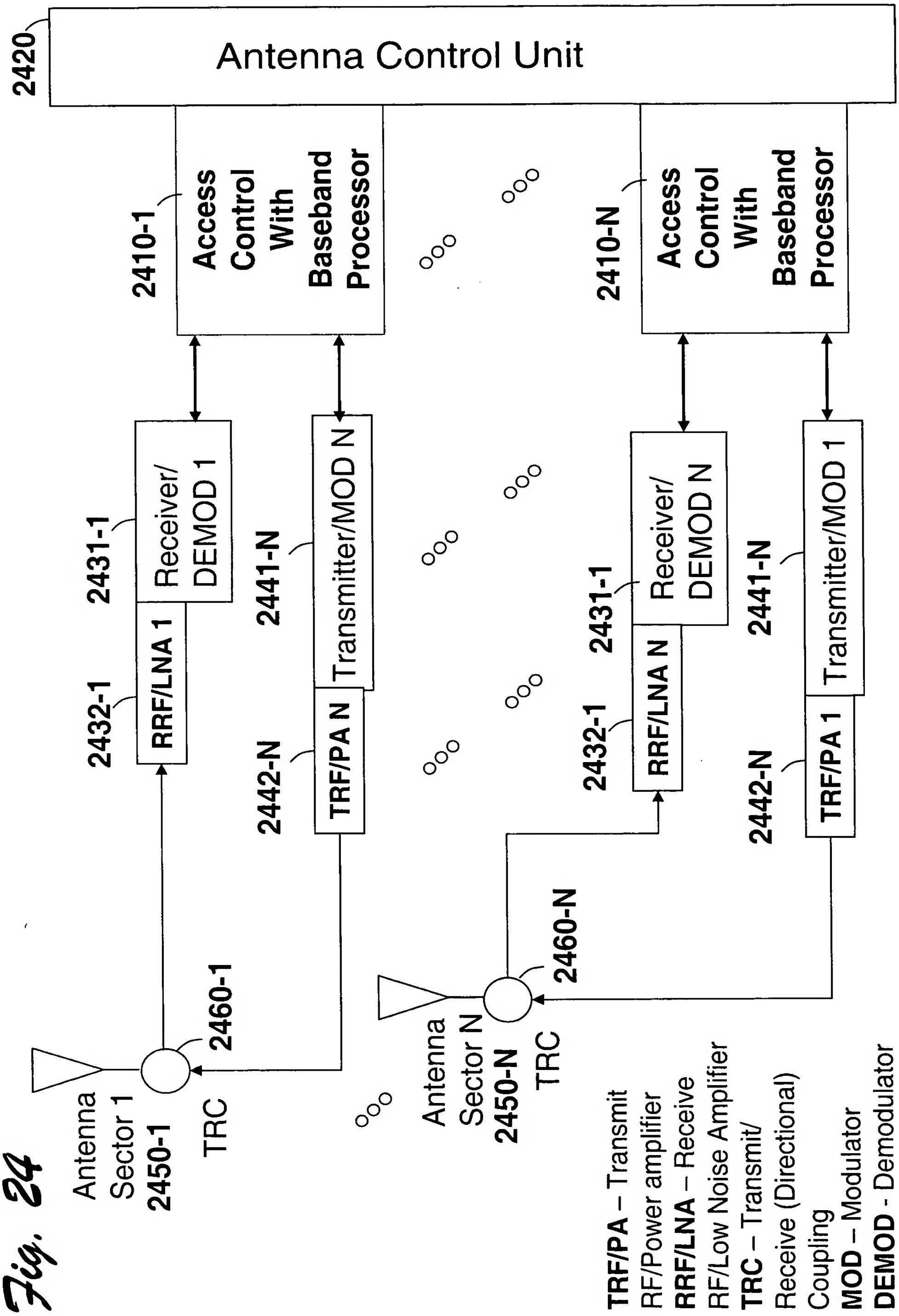

2420
Antenna Control Unit
2410-1
Access Control With Baseband Processor
2410-N
Access Control With Baseband Processor
2431-1
Receiver/ DEMOD 1
2432-1
RRF/LNA 1
2441-N
Transmitter/MOD N
2442-N
TRF/PA N
2431-1
Receiver/ DEMOD N
2432-1
RRF/LNA N
2441-N
Transmitter/MOD 1
2442-N
TRF/PA 1
Antenna Sector 1
2450-1
TRC
2460-1
Antenna Sector N
2450-N
TRC
2460-N
TRF/PA – Transmit RF/Power amplifier
RRF/LNA – Receive RF/Low Noise Amplifier
TRC – Transmit/ Receive (Directional) Coupling
MOD – Modulator
DEMOD - Demodulator

Fig. 24

Fig. 25

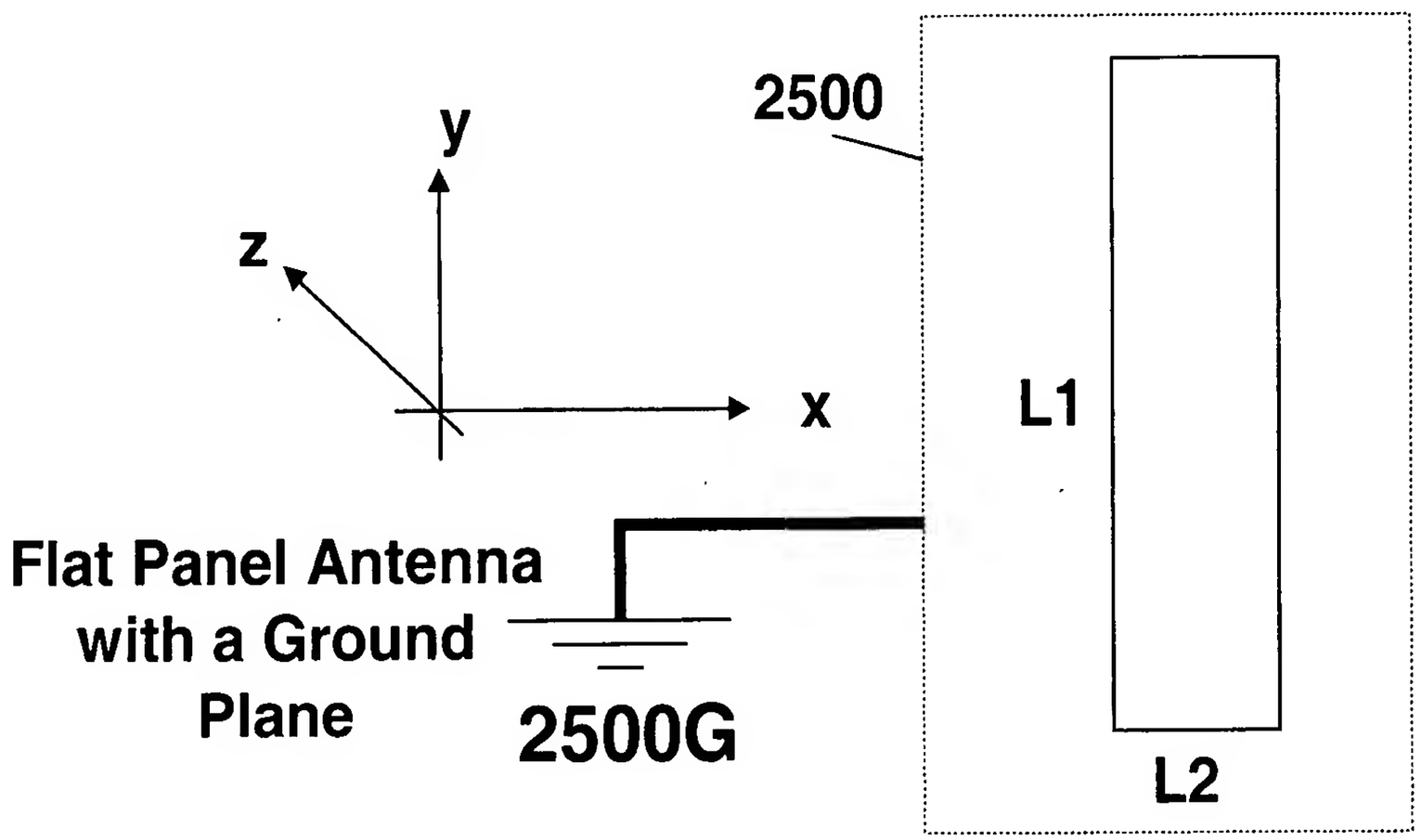
Flat Panel Antenna Sector Design

2511. $g_{max} \approx 4*(3.14)*\{(L1*L2)/(Lambda^2)\}$ **[Lambda = speed-of-light/Frequency]**
[A=L1*L2 is the rectangular area of **antenna aperture** in cm ^{2}]

2512. Lambda/L1 and Lambda/L2 are the beam widths –
in radians (57.3 degrees)

Aperture

2513. Antenna Gain: $G(db) = 10 \log_{10}(g_{max}) \approx 10 \log_{10} [12.5*A / Lambda^2]$



L1-by-L2
Flat Panel Antenna Sector
Wherein:
- **L1 is in the x-y plane**
- **L2 is in the z direction – 90 degree with respect to to the x-y plane**

However:
- **L1 may be tilted in the z direction**
- **L2 may be tilted in a defined angle with respect to the x-y plane**

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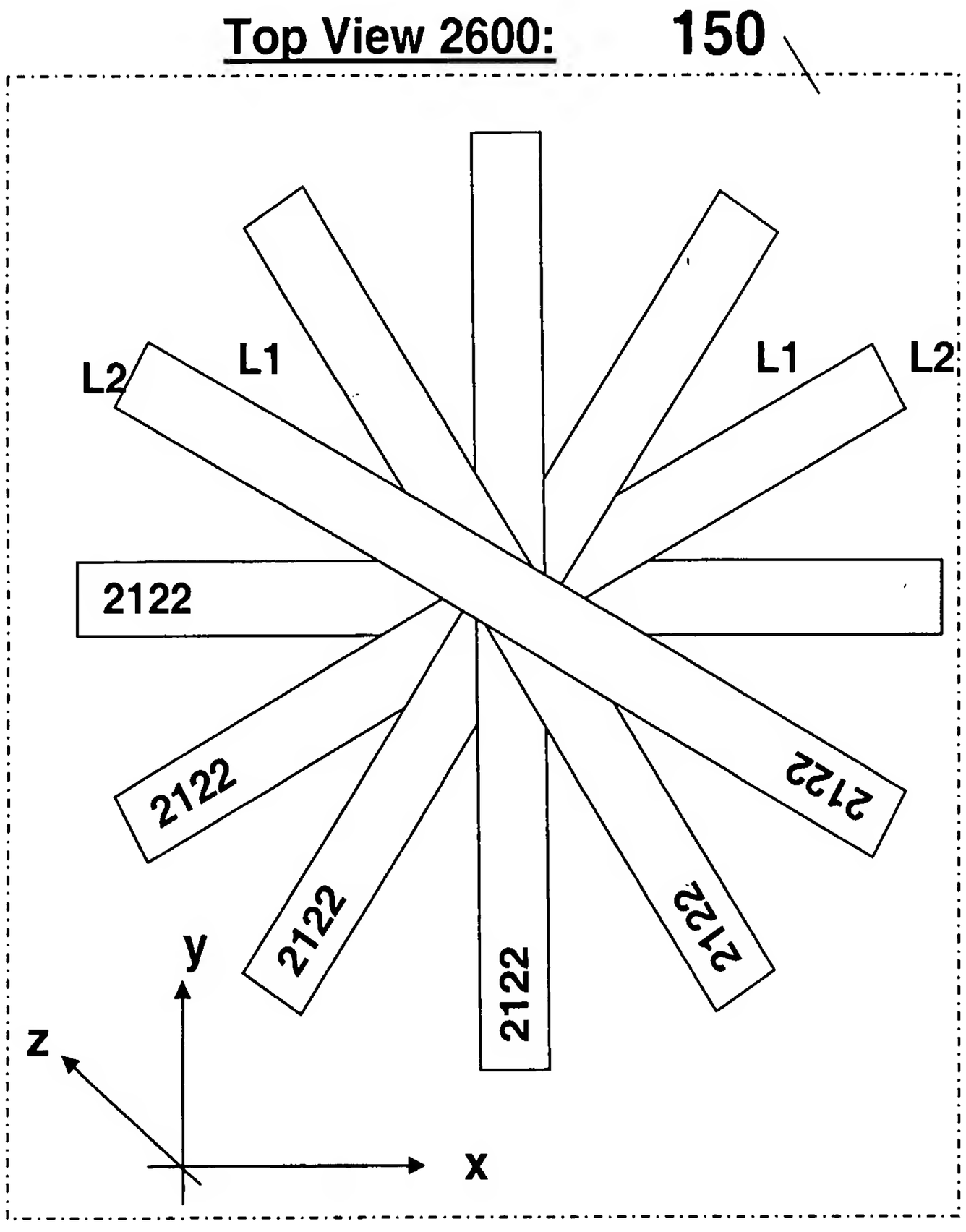
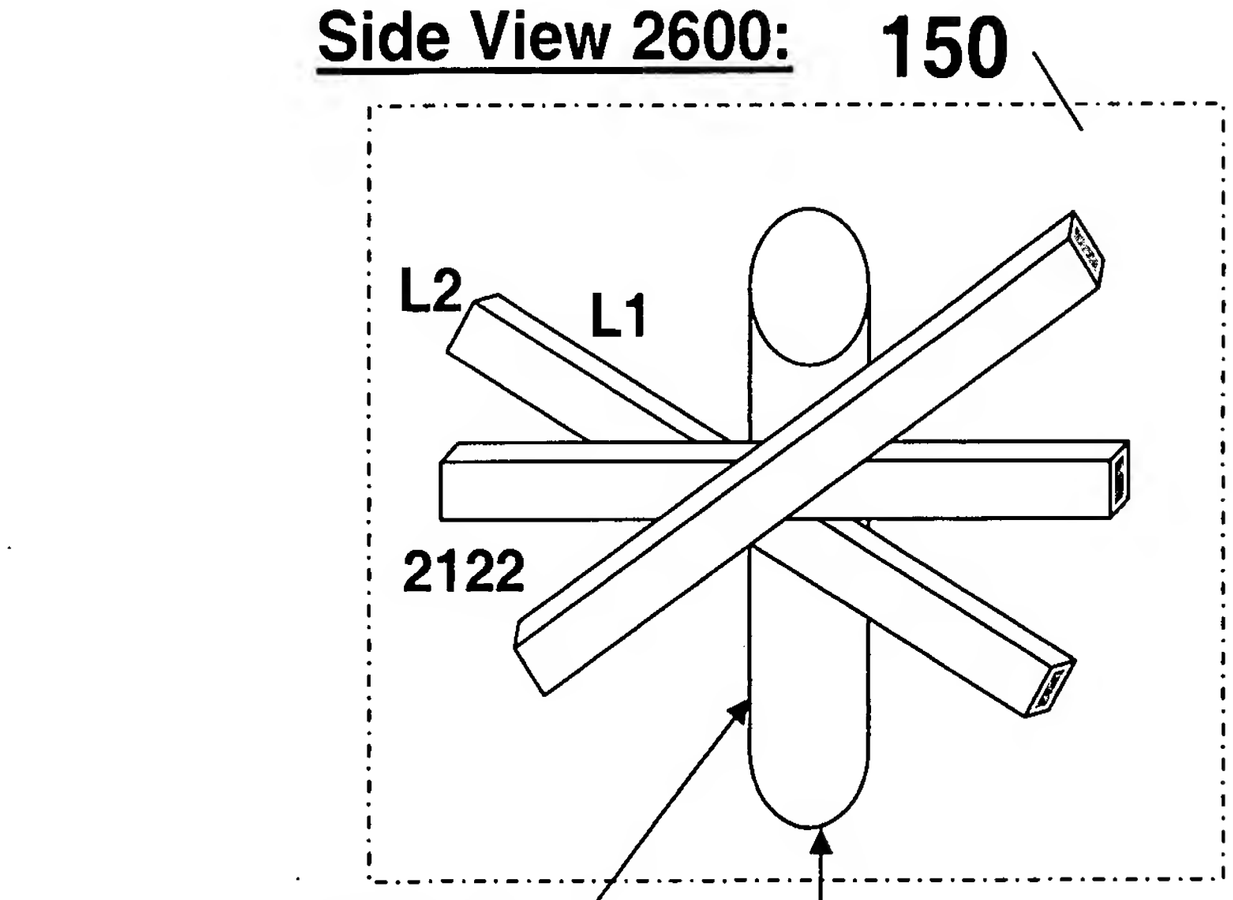
Fig. 26

Plurality of Vertically Stackable Flat Panel Antenna Sectors

- Each sector consists of plurality of "patches" may be tilted along L1 and/or L2
- Ground and dielectric planes are not shown





2620-H

Move in the θ - Direction Signal

2620-V

Move in the ϕ Direction Signal

Moveable Direction:
Motion Control Signal in Two Circular Coordinates: v(θ,ϕ)

Fig. 27

Plurality of Vertically Stackable Tube-like/Yagi Antenna Sectors

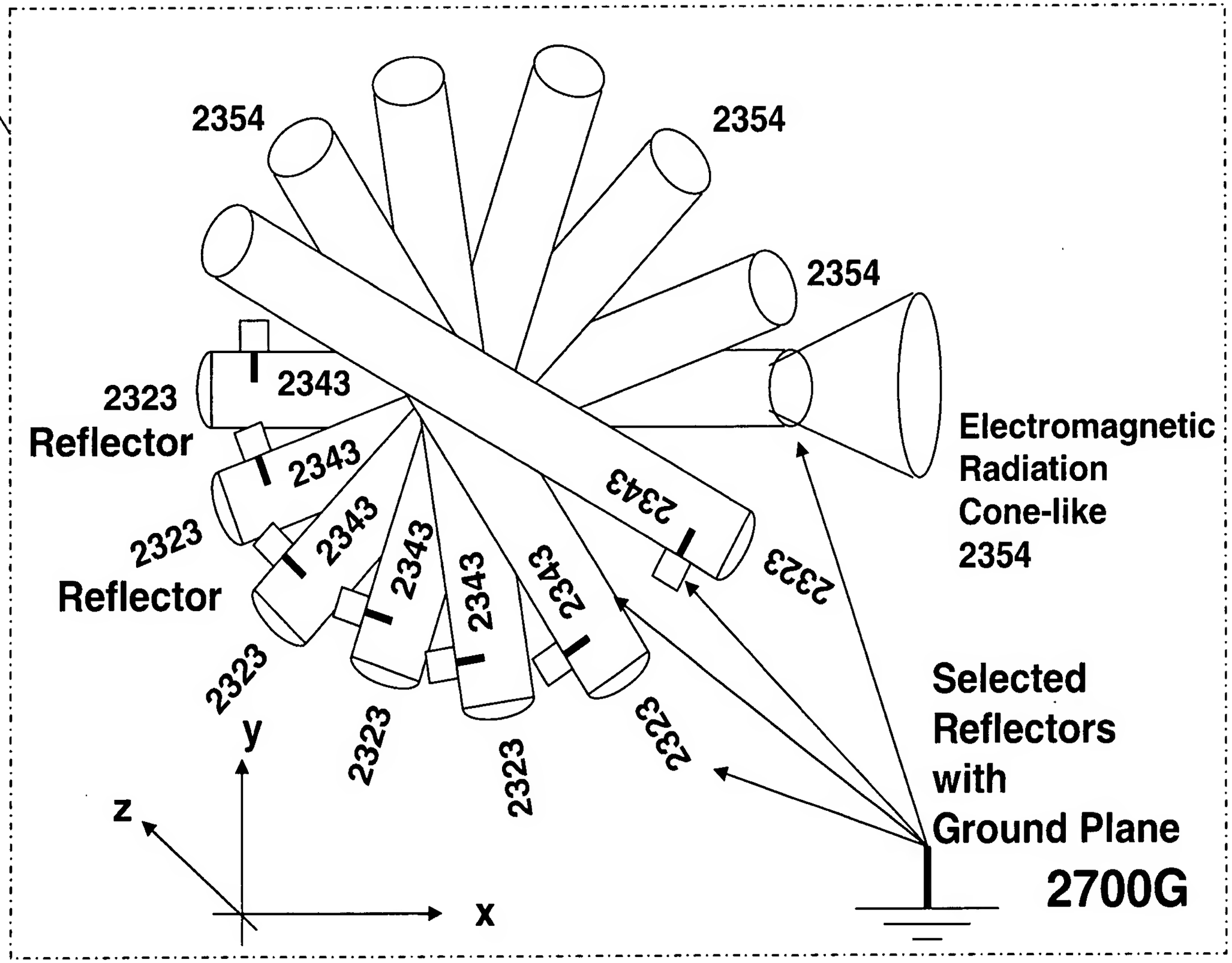
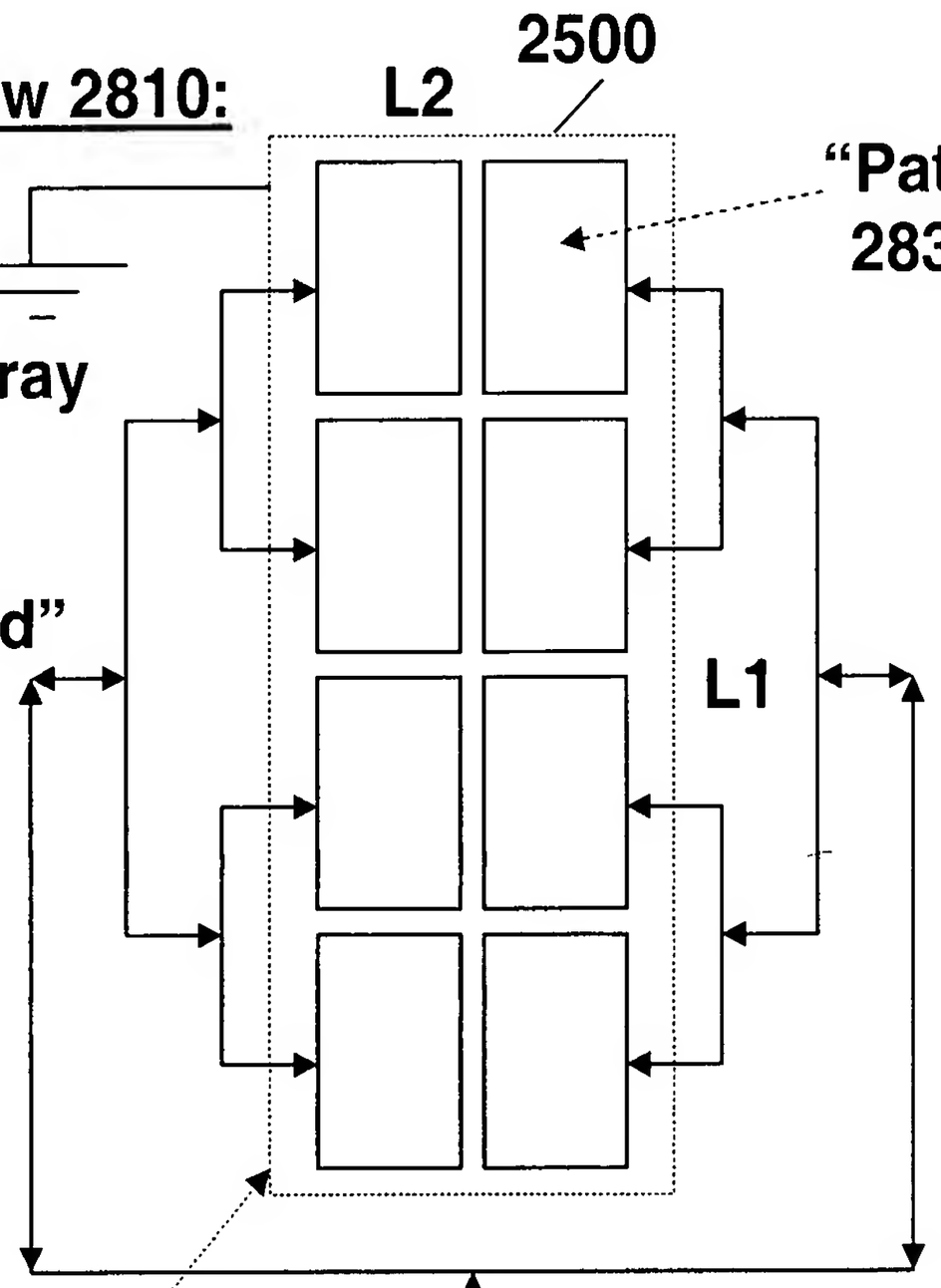


Fig. 28

Flat Panel Antenna Sector

Front View 2810:

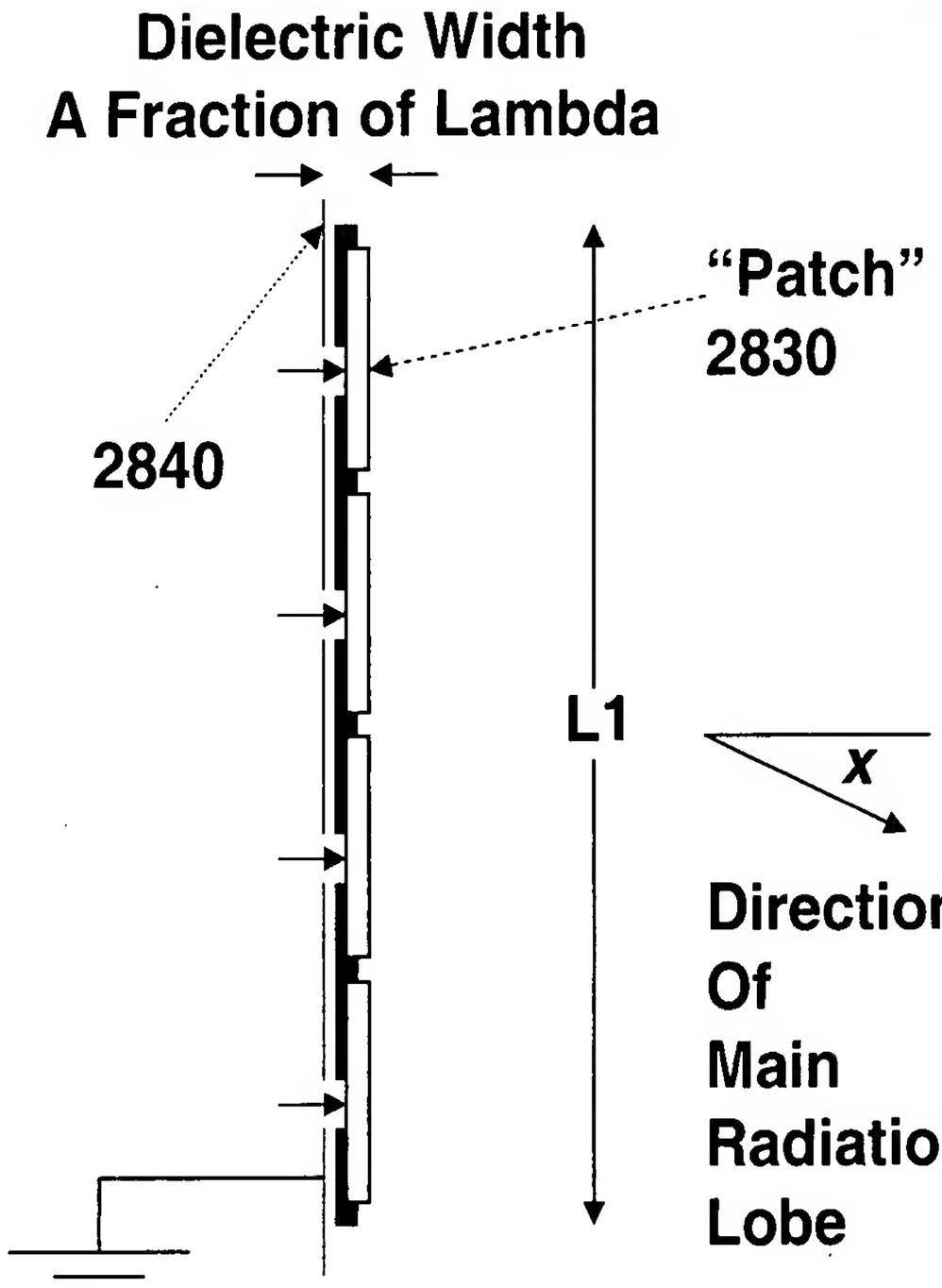


2500
Static Phase Array
Structure with
Plurality of
"Patches" - "Fed"
with Phase
Shift Signals
via Wires
Of Predefined
Lengths

2840
Predefined Dielectric
Material and Ground
(with a Fraction of Lamnbda
Margins Around the Patches)

2850
Transmit/Receive
Signal

Side View 2820:



Direction
Of
Main
Radiation
Lobe

$$\text{Aperture} \approx L1 * L2 * \cos(x)$$

Fig. 29

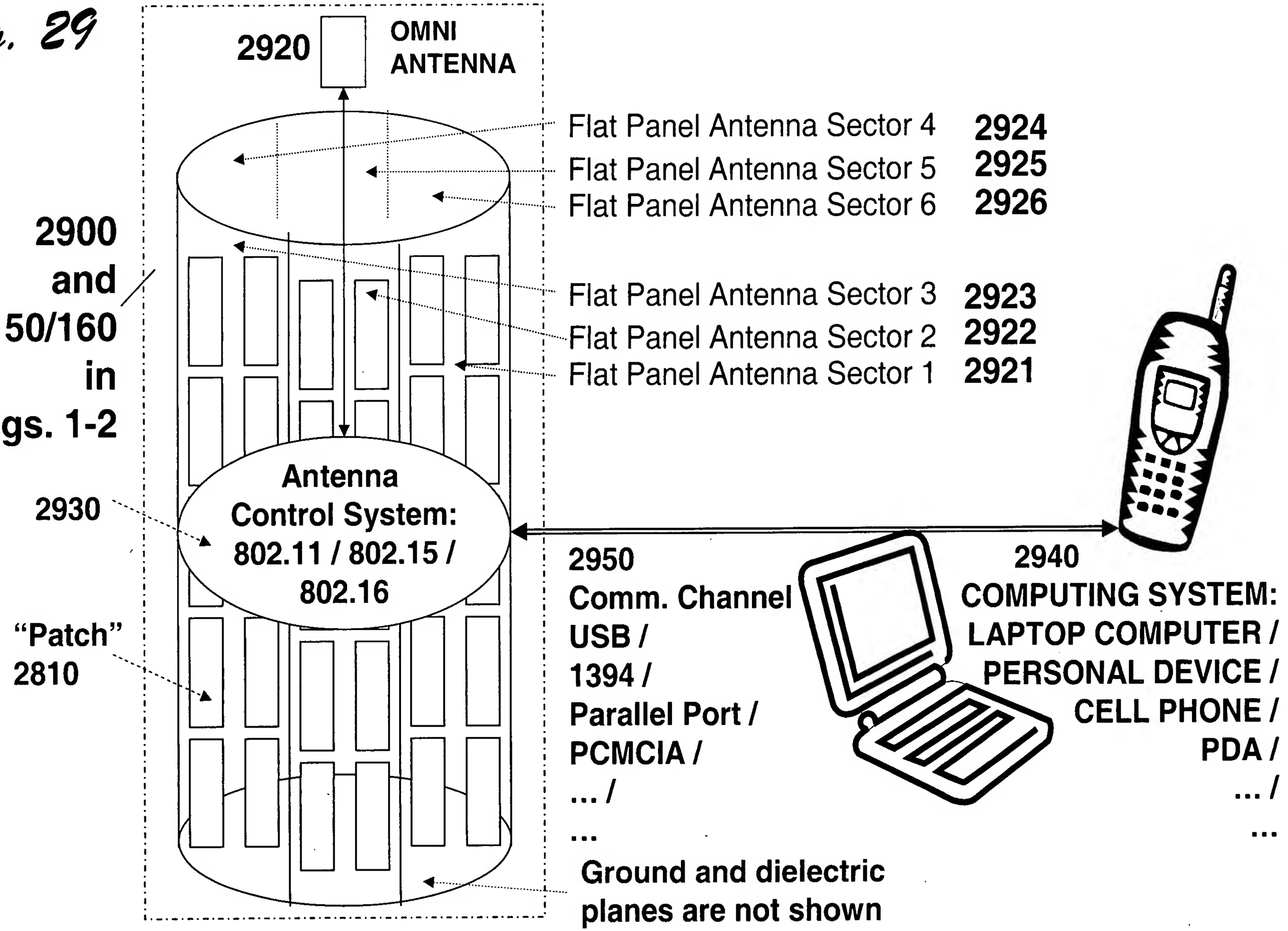

2920
OMNI ANTENNA
Flat Panel Antenna Sector 4 2924
Flat Panel Antenna Sector 5 2925
Flat Panel Antenna Sector 6 2926
2900 and 150/160 in Figs. 1-2
Flat Panel Antenna Sector 3 2923
Flat Panel Antenna Sector 2 2922
Flat Panel Antenna Sector 1 2921
Antenna Control System: 802.11 / 802.15 / 802.16
2930
"Patch" 2810
2950
Comm. Channel
USB /
1394 /
Parallel Port /
PCMCIA /
... /
...
2940
COMPUTING SYSTEM:
LAPTOP COMPUTER /
PERSONAL DEVICE /
CELL PHONE /
PDA /
... /
...
Ground and dielectric planes are not shown

Fig. 30

Plurality of Flat Panel Antenna Sectors Radiating Electromagnetic Signals in Predefined Direction in Space – Selected Panels can be Tilted

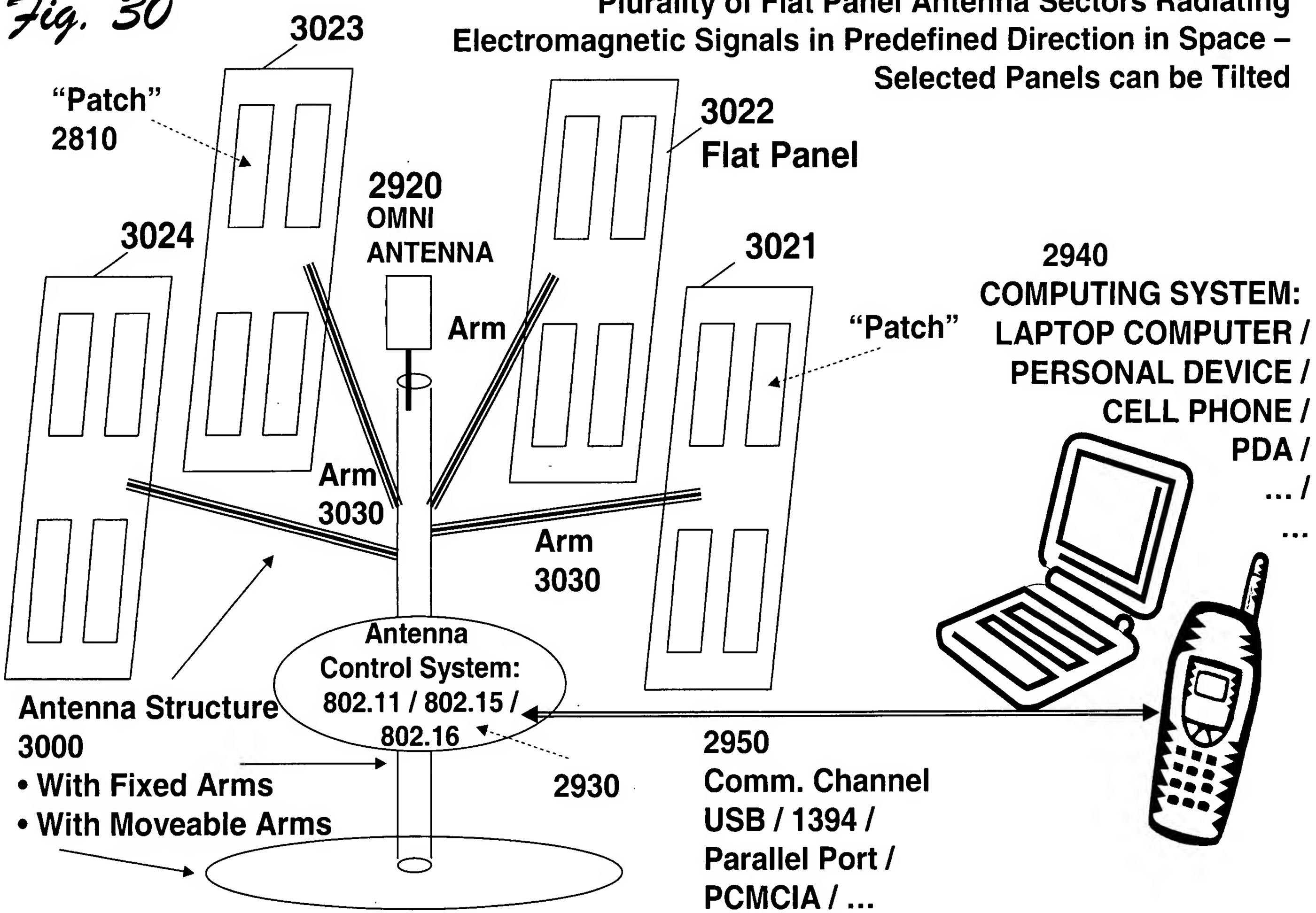
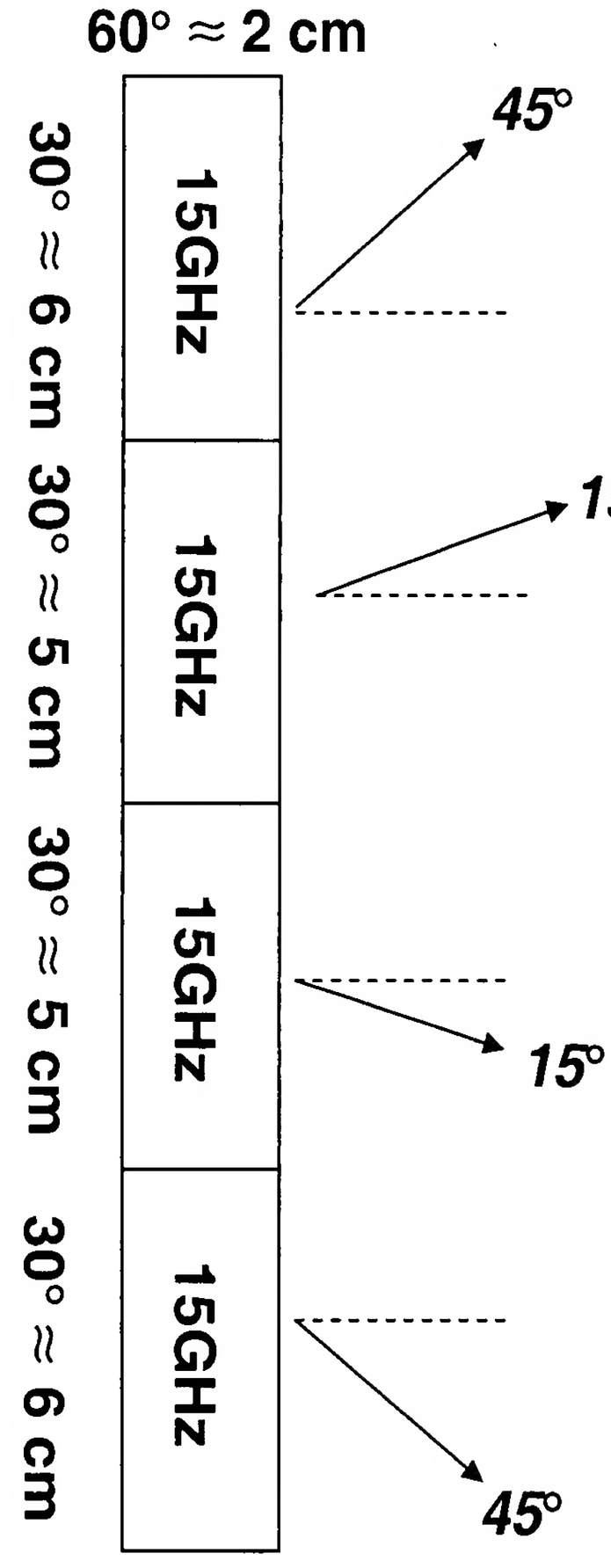


Fig. 31

A Vertical Slice of Cylindrical Shape Structure
(6 Vertical Slices with Hexagonal Arrangement for Covering 360°)



Vertically Stackable For Quadruple Spatial Coverage

Direction Of Main Radiation Lobe (3db)